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ABSTRACT

The transcript of the hearing that examined S. 1951, a bill to establish a Federal Interagency Council on Science, Mathematics, and Technology Education, is presented. The purpose of the bill is to promote cooperation and coordination among the dozen or so federal agencies that administer programs in science and math education. Witnesses include the following officials: (1) John Andelin, Office of Technology Assessment; (2) Christopher T. Cross, Office of Educational Research and Improvement; (3) Mark O. Hatfield, Senator from Oregon; (4) Sue Kemnitzer, former executive director, Task Force on Women, Minorities, and the Handicapped in Science and Technology; (5) J. Thomas Ratchford, National Science Foundation; (6) Richard E. Stephens, Department of Energy; and (7) Luther Williams, National Science Foundation. The text of S. 1951, the prepared statements of witnesses in order of appearance, a report on "Coordination of Programs on Mathematics and Science Education for the Department of Education, the National Science Foundation, and Other Agencies," and a letter to Senator Glenn from Christopher T. Cross dated June 14, 1990 are appended. (KR)

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S. HRG. 101-893

INTERAGENCY COUNCIL ON SCIENCE AND MATH EDUCATION

HEARING

BEFORE THE

COMMITTEE ON GOVERNMENTAL AFFAIRS UNITED STATES SENATE

ONE HUNDRED FIRST CONGRESS

SECOND SESSION

ON

S. 1951

TO PROMOTE INTERAGENCY COOPERATION IN THE AREA OF SCIENCE, MATHEMATICS AND TECHNOLOGY EDUCATION

JUNE 14, 1990

Printed for the use of the Committee on Governmental Affairs

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INTERAGENCY COUNCIL ON SCIENCE AND MATH EDUCATION

THURSDAY, JUNE 14, 1990

U.S. SENATE,
COMMITTEE ON GOVERNMENTAL AFFAIRS,
Washington, DC.

The Committee convened, pursuant to notice, at 9:40 a.m., in room SD-342, Dirksen Senate Office Building, Hon. John Glenn, Chairman of the Committee, presiding.

Present: Senators Glenn, Heinz, and Akaka.

OPENING STATEMENT OF CHAIRMAN GLENN

Chairman GLENN. The hearing will be in order.

This morning we will examine S. 1951, a bill to establish a Federal Interagency Council on Science, Mathematics, and Technology Education. My good friend Senator Hatfield and I introduced this bill. Among the many cosponsors are Senators Bingaman, Lieberman, Kohl, Nunn, and Heinz. The bill's purpose is to promote cooperation and coordination among the dozen or so Federal agencies that administer programs in science and math education.

Better Federal coordination in this area could not come at a better time. The lessening of tensions around the world signify to me that the emphasis on military competition is being replaced by an emphasis on economic competition. Already 70 percent of the goods manufactured in the United States compete with merchandise made overseas. We ought to consider then what it will take to succeed in an even more competitive global market.

I believe that the winners will be those nations whose citizens build the highest quality and the most technologically advanced products in the world. I want the United States to be that nation, to be a winner. Our citizens—that is, our scientists, our engineers, our factory workers—must all excel at technological innovation.

The challenge is simple. The U.S. needs a world class technical work force. The problem: we may not get one.

In testimony before this Committee, Carl Sagan reported that 94 percent of Americans are functionally illiterate in science and math. Moreover, American young people are routinely outclassed in international comparisons. In a recent comparison involving 13 nations, U.S. 12th graders finished dead last in biology, 11th in chemistry, 9th in physics.

The United States also faces a potential shortage of scientific personnel. The National Science Foundation projects a shortfall of

over 600,000 by the year 2020 owing to declining interest in scientific careers, as well as declining birth rates.

On top of that, groups that have been traditionally underrepresented in science and math are entering the work force in increasing numbers. Blacks and Hispanics, now 25 percent of our school children, will constitute almost half by the end of this decade. We must encourage more women and minorities to study science and math and to enter the scientific pipeline.

I have just described for you what I think is the problem. Now let's look at one part of the solution. We can debate whether or not the Federal Government should take more of a leadership role in science and math education. The plain truth is that it is already an important player. More than a dozen agencies spend over $1 billion a year on science and math education, but the lack of coordination seems evident. Many educators have criticized the two lead agencies, NSF and the Education Department, for not cooperating very well, if at all. And the mission agencies administer their own educational programs quite independently of both NSF and the Education Department.

The stakes are too high and the cost too expensive for the various agencies to continue to offer programs without regard to what other agencies might be doing. And, I might add, without regard to what our national education goals and priorities are. If we are serious about accomplishing these national goals, the Congress ought to insist that the Executive Branch coordinate its education programs for maximum effect. Establishing an Interagency Council is one way to promote this.

What else will it do? The Council might prevent some problems from falling through the cracks. Some educators believe that within the last decade or two elementary science education did just that. Lapses like this should not happen.

Our objective in establishing this Interagency Council is really quite simple: Better cooperation and coordination. The administration obviously agrees with this goal. It recently appointed an interagency committee under the auspices of the Federal Coordinating Council on Science, Engineering and Technology, or FCCSET, usually referred to as "fix it," an appropriate acronym.

But there are important differences between the panel proposed by S. 1951 and the newly created FCCSET Committee. The panel in S. 1951 would be permanent. The FCCSET Committee goes out of business at the end of 1991.

No one believes our education problems will be fixed by then. They will require long-term solutions requiring continuous ongoing collaboration and coordination.

The second difference is the identity of the chairperson. S. 1951 designates the President's Science Advisor as the permanent chairperson. Dr. Bromley appointed Admiral Watkins chair of the FCCSET Committee. Now, I very much admire Admiral Watkins and what he's doing. And I know personally from talking to him of his long-term interest in science and math education and how necessary it is going to be for our country for the future. So as much as I admire Admiral Watkins, I am a little uncomfortable that the chairperson of an science education interagency council heads an agency that does not have institutional commitment or responsibil-

ity for science education. I also understand the hesitation in elevating the NSF director above the Education Secretary in these matters. And that is exactly why we chose the President's Science Advisor. Working in the Executive Office of the President, he or she can be the honest broker between the NSF, the Education Department, and the mission agencies.

Another major difference is the reporting requirements found in S. 1951. S. 1951 requires the Interagency Council to report its findings and activities to the Congress. And in this bill, the National Academy of Science is asked to evaluate Federal programs in science education. The FCCSET panel will do neither of those.

So I look forward to hearing from our witnesses today and I hope we can resolve some of our differences so we can move quickly to bring this bill to markup and on to the Floor.

Senator Lieberman has submitted a statement for the record and we will include that at this point in the record.

[The opening statement of Senator Lieberman follows:]

OPENING STATEMENT OF SENATOR LIEBERMAN

Mr. Chairman, while the 1980's have been a time of economic success for many in America, the decade also brought us a new set of challenges—a ballooning budget deficit, an unprecedented trade deficit, and record low savings and investment rates. Now, as we enter the 1990's, the United States finds itself trailing far behind our competitors in the basic task of educating our work force, thus impeding our ability to maintain a competitive edge in a changing world economy.

For almost thirty years the United States' attitude toward the quality of our educational system and the quality of our work force has been one of benign neglect. In fact, not since the 1957 launch of the Soviet Sputnik has there been such an intense focus placed on the decreasing "technical and scientific literacy" of this country's young people. In 1957, the focus was the result of a contentious cold war relationship with the Soviet Union. In 1990, at the end of the cold war, we find ourselves with a similar focus, but this time it is the result of the declining ability of the United States to compete in the global marketplace. Many attribute this decline, in part, to a deterioration of U.S. educational performance.

There has been much discussion in the media, among scholars, and in Congress about how ill-prepared our work force is to perform the jobs businesses need done, and how this gap between jobs and the skills of applicants will continue to grow as we approach the 21st century.

Our education system is failing to keep students in school or teach them the skills they need. As a result, employers must spend millions of dollars to "re-educate" employees. The problem has become so serious that:

One million people drop out of high school every year, almost 50% in some inner city schools;

Of the 2.4 million who graduate from high school, 25% cannot read or write at an eighth grade level; 20% of Americans are functionally illiterate;

It is not surprising that in recent years, U.S. students have been out-performed by students from Japan, West Germany, and the United Kingdom in virtually every major assessment of science and mathematics educational achievement.

Congress has focussed on our inability to compete in the new global marketplace, but equal attention has not been placed on our decreasing productivity. According to the Congressional Research Service, between the years 1972 and 1986 the productivity of U.S. manufacturing workers grew only modestly while Japanese workers doubled their productivity. There is an important connection that can be made between productivity and education. First, historically, the significant growth in the U.S. economy in the first half of the twentieth century has been attributed to increases in human capital or the expansion of workers' knowledge. Second, a more highly educated work force will be necessary to meet the technical requirements of the work place productivity of the future.

A survey by the National Science Teachers Association concluded that "of the 24,000 high schools in the U.S., 29.6 percent offered no physics courses; 17.5 percent offered no chemistry; and approximately 8 percent offered no courses in biology."

Additionally, surveys suggest that only "60% of U.S. students take biology, 30% take chemistry, and only 15% take physics".

In mathematics, the National Research Council reported that "non-U.S. citizens who take the Graduate Record Examination in mathematics average 100 points higher than U.S. students, and that the mathematics achievement of the top 5% of twelfth grade students is lower in the United States than in other industrialized nations." The average twelfth grade mathematics student in Japan out-performs 95% of comparable U.S. twelfth grade students.

In order to improve our students' educational achievement, particularly in the areas of science and math, we must look at our entire educational system. We must review the curriculum, the instructors, and the ways in which we motivate students, especially those students who are most likely to drop out or otherwise ignore educational opportunities.

We need to work on federal solutions to the problem of an educational system that isn't producing workers with the skills we need in the 1990's and beyond.

Mr. Chairman, this is why proposals like S. 1951 are so important to our future success, and why I am so proud to be a co-sponsor of this legislation.

Finally, Mr. Chairman, President Lyndon Johnson once said that "we must open the doors of opportunity. But we must also equip our people to walk through those doors." We spend a lot of time deliberating on growth and opportunity, but we rarely consider the requisite components necessary to achieve such growth. Clearly, excellence in science, math, engineering and technology is an indispensable part of that formula.

Chairman GLENN. We are honored this morning to have the Honorable Mark Hatfield. His interest in educational matters is legendary around here, and back in his State also. He has been a leader in this area and we are honored to have him as our first witness this morning.

Senator HEINZ. Mr. Chairman, could I just welcome our distinguished Senator from Oregon here today?

Chairman GLENN. I'm sorry. I should have called on my distinguished colleague here. Go right ahead.

OPENING STATEMENT OF SENATOR HEINZ

Senator HEINZ. I welcome him not only because he was the Chairman of the Appropriations Committee, and is Ranking Member, and that is important to many of us, I want him to know. But I salute him because he is the person who raised this issue last year with S. 1951, and I am pleased to cosponsor it. It was the Appropriations Committee under his leadership that in the fiscal year 1990 appropriations process requested that the Office of Science and Technology Policy report on the coordination of math and science education. It is because of that initiative that Allan Bromley appointed Jim Watkins to head up the FCCSET Committee. All of that would not have happened, Mr. Chairman—I know you know this—without the initiative of the distinguished Senator from Oregon.

So the first thing I want to do is thank him for already achieving much of what his legislation seeks to achieve. Secondly, as Chairman Glenn points out, we do have a very serious problem. The Senator from Oregon has over the years reminded us, year in and year out, about the effectiveness of our math and science education. It is a genuine national embarrassment and concern when we learn that something like 40 percent of Korea's 13 year old students understand geometry and measurement concepts and are successful at solving even more complex problems, when less than 10 percent of our students at the same age level have the same skill level. And it gets worse after that.

So, Mr. Chairman, I commend you on this hearing. I thank the Senator from Oregon for his initiative and leadership in this area. I hope we can get into the Senator's views on whether the Administration has gone far enough, or whether the Senator from Oregon feels that it is indeed still a good idea to, in effect, change leaders at this point, move from Jim Watkins to Allan Bromley.

Secondly, whether or not this should become a permanent interagency process. Thirdly, whether we do want more paper coming down to the Congress, maybe we do, in the form of a biennial report. I would only make this comment. I think it is unfortunate that the Administration had to be told by us here in the Congress to do what they finally did, especially since this President, who I greatly admire, campaigned on the platform of being the education President, and I would have preferred—indeed, I would have hoped—that the initiative by President Bush would have been taken long before Senator Hatfield had to introduce S. 1951 to remind us, the President included, what needed to be done.

Thank you, Mr. Chairman.

Chairman GLENN. Thank you.

Senator Hatfield.

TESTIMONY OF HON. MARK O. HATFIELD, U.S. SENATOR FROM THE STATE OF OREGON [1]

Senator HATFIELD. Thank you, Mr. Chairman and Senator Heinz. I must say I feel that I am in a friendly court today and I am grateful for your kind remarks.

Gentlemen, I think we are at a point where just a moment or two of reflection to bring us to this particular hearing is important. Senator Glenn, 2 years ago you and I cosponsored a Sense of the Senate resolution, obviously non-binding, calling attention to this problem of the deficiency in math and science, and we only found a handful of cosponsors at that time.

It is interesting, today you can hardly pick up any part of the media, visual or written, that doesn't have some topic from time to time on this problem, this national crises, as you call it, and it is well-named as a national crises. In fact, we are told by different statistics that within this decade we will be shy or a shortfall of 700,000 engineers. We have all kinds of statistics and, unfortunately, statistics sometimes just become statistics. But I want to commend you and Senator Heinz for your strong support and your leadership in the dealing with this particular crises.

I think also it is well to recognize that all three of us have been in the Senate for a period of time where we recall for almost the last decade we had leadership that was trying to dismantle education as a role in the Federal Government. From the abolition of the Department of Education to other kinds of almost attack no education as a Federal responsibility, as a Federal role. I remember chairing the Appropriations Committee for the 6 years of that almost decade, and each year we saw these ridiculously low budget requests coming out of the Administration for support and for un-

[1] See p. 46 for Senator Hartfield's prepared statement.

dergirding the commitments we already had in education, and the role of the Appropriations Committee was to restore those funds.

In 8 years we transferred $100 billion from the request level of military spending and applied them to these other areas of our responsibilities, including education got a major part of those $100 billion. So now we have a President who I think should have a great deal of credit for helping to elevate this problem of the math/science deficiency when he made the centerpiece of his State of the Union address this very issue.

Now, it is one thing to talk about the issue, but I would also say for the record that if you look at the budget request, we have about a billion dollar increase from the Administration as a request for applying to different programs in education. I think one of the great problems is that we respond so oftentimes only in crises, and I talk to education groups—as I am sure each of you have done—to find their concern expressed, well, if you elevate the math/science and you focus so much on math/science, are you merely redistributing the resources, or are you really giving new resources to address the issue? And they are concerned about Title I, as they well should be. They are concerned about the Head Start program, that we are only funding a little bit more than a quarter, 26 percent, of the eligible children that could be benefited by Head Start. And I think part of our task is to illustrate by action that we are not lessening our commitment to these ongoing programs of education by our focus on math/science.

Mr. Chairman, back in 1937 I believe it was, President Roosevelt launched the first study of the Federal Executive Branch of Government, looking for a more efficient, better coordinated system for the Executive Branch. Later that was followed by Mr. Truman, Harry Truman, who appointed former President Herbert Hoover to head up a major reorganization study in 1947, and later Hoover Commission No. 2 under President Eisenhower, and more commissions later on, and the latest being the Gates Commission.

Unfortunately, those commissions, you know, make their report, and I guess the first Hoover Commission got the major part of its recommendations adopted, and it dwindled down in the second Hoover Commission, and not a great deal of the Gates Commission has been adopted.

But each one of those commissions indicated that one of the major problems was that we weren't getting a maximum benefit out of the great resources we already had at hand in Federal structures, whether it be in the Executive Branch or the relationships between them, with the Congressional Branch. And so I think that what your bill, S. 1951, really sets forth is fundamental. It is not a matter of being critical in terms of a lack of resources or able leadership. You will be impressed by your witness list, as I am, to know these individuals and to know the agencies they represent. But I think the real key is in the coordination between these separate and distinct agencies. Don't we have problems even within the Congress, within the Senate of the United States, of coordinating even between our own structural committees and activities. And then when you multiply that many-fold, as is true in the Executive Branch of Government, coordination really has to become a strate-

gy. It can't just happen. You can't just say, well now, to one agency, be sure that you coordinate with another agency.

I think the President's response to this has been well taken in his setting up under Admiral Watkins this Interagency Coordinating Council. I think your bill, our bill, is very correct in wanting to make this permanent. And I think, again, it is correct in wanting to establish it as close to the presidential leadership as possible. We all know that presidents use and have different styles as far as their cabinets are concerned. We also know that in any administration there are the influential members and there are the less influential members within the Cabinet. Whereas when you have a White House office that has far greater access probably to the President under general conditions than most of the Cabinet people, perhaps with the exclusion of the Secretary of State and Secretary of Defense, I think it is very appropriate to have Dr. Bromley's office become the center of this coordination.

I also want to say, Mr. Chairman, Senator Heinz, that the coordination within the Federal Government itself has to also be related out to the field where that coordination and the resources that are represented in the Federal agencies can be easily transferred, easily communicated. And that, of course, is the purpose of your and my bill that deals with the 9 consortiums that we want to set up around the country to be the recipients of this central coordinating activity, and also to bring a two-way flow, bringing from the field back into the coordinating council.

It doesn't do much to just coordinate within the central government if there isn't a good network of communication in both directions outside of the central government. so I think the combination of these two bills really addresses a very fundamental need.

When I say the two-way flow, I have held a field hearing out in my State on the bill that relates to these nine consortiums out across the country, and, again, I was impressed by the success stories that we have out there. Senator Heinz mentioned some of the data that illustrates the crises we are in, but in spite of that data—and it is accurate, I have seen data, and you can find it a mile long, that illustrates our deficiencies—but in spite of all of those deficiency reports, we are still experiencing some extraordinary success stories. And I think they are very important to crank into this whole network in this system.

For instance, you take Hewlett Packard, you can take Chevron, you can take Upjohn Drug Company, you can take NCR, the National Cash Register. More and more private industry is finding more difficulty in acquiring the trained personnel out of the normal school systems, and they have become then a participant, a partner in trying to employ their resources not to displace the schools but to undergird and to help provide some of the deficiencies within the schools. Local school budgets are difficult to pass in my State today, and I understand that is true in other States. I need not say that 7,000 of our 25,000 high schools today are no longer offering physics, and 4,000 are no longer offering chemistry, and 2,000 are no longer offering biology. Of the ones that still offer those courses, only a third of them provide a laboratory, hands-on experience.

I could go on with these other dismal statistics. So the private sector, industry and business that depends upon that kind of personnel to sustain their own enterprises, are beginning to move in. I think also within education there are many exciting things that are happening to stimulate teachers, to stimulate students, and through especially with the computers. We have at Grant High School, one of our major high schools in Portland, they have a satellite which they have access, and they are communicating with a high school in Massachusetts, in Boston, and exchanging an environmental database. It is very exciting to see a classroom like that.

I also want to pay special tribute to those informal sources of education that ought to be cranked into this network. We have what we call the Oregon Museum of Science and Industry. There is a fantastic similar institution, probably the greatest in the Nation, in Chicago, and there are such around the country, zoological gardens with their educational programs. A lot of these informal resources of education can become a great help in addressing these deficiencies.

So, Mr. Chairman, I would be happy to respond to your questions. I just want to commend you for your leadership, for Senator Heinz' leadership, and to indicate that we are but taking a small step in trying to set up this central coordinating council that Admiral Watkins has already proven the worth of. I think anybody who knows Admiral Watkins knows that he is extraordinary, and I think what he is doing is a marvelous and extraordinary thing. But we have to look beyond Admiral Watkins and we have to make sure the structure is there that whoever succeeds in the years to come will carry this on and have the closest possible access to the ear of the President, because as we have seen, the Eisenhower scholarships increased under President Bush's proposed budget, as we are seeing these other evidences of greater support for education—and I would like to say that when we talk about $1 billion, it is a heck of a lot of money, but on the other hand we have to realize that we are still in a catch-up position. We are not really at a point where we are expanding or adding major new opportunities through these resources. We are still in a catch-up and it is going to take a lot more than a billion dollars. But it has to be wisely spent, and I think such a council will guarantee to the taxpayer that these additional resources that will be expended now and in the future will be maximized as far as the benefit that they are to represent.

So I am just happy to be a part of this activity in which you have given great leadership.

Chairman GLENN. Thank you very much, Senator Hatfield. That is an excellent, excellent statement.

Senator HATFIELD. May I submit my regular statement for the record?

Chairman GLENN. Your formal statement will be included without objection in the record.

He mentioned the concurrent resolution last year on this. Also, I think it would be good to note our proposal to create regional consortiums to implement a science and math curriculum, and a national clearinghouse to store and evaluate science and math materials. Those are two other efforts that are ongoing.

Trying to reap the maximum benefit from the dollar spent is exactly what this is all about and that is what you addressed. I would say that I hope that this can be an example also for the States. While you were talking, I was recalling when Ross Perot in Texas was asked to look into the Texas educational system. I believe it was rated as something like 47th out of our 50 States and they wanted to find out what the problem was. This was back in 1984 or 1985, I believe. And what he came up with I thought was rather interesting. He found that of the money spent in the Texas elementary and secondary education system, in the high schools in particular, 30 percent of the money went to good solid academics; another 30 percent went to what he termed soft electives; and 40 percent went to administrative and extracurricular activities.

Now, the part that got my attention—since I lived down at the space center near Houston for a number of years when my children were in their high school years—was he found that 65 percent of the principals of Texas high schools were coaches. Now there's nothing wrong with coaches being principals of high schools; I am not trying to indicate there is anything wrong with that. We have some brilliant coaches who are good educators. But when you have 65 percent of your high school principals are coaches, it indicates maybe a slant in the educational system.

Senator HEINZ. Mr. Chairman, I apologize. I have another Committee that I must go to. You are doing a fine job. This is a little bit like a meeting of the choir.

Chairman GLENN. Mark and I can sit here and talk all day about this.

Senator HEINZ. I have no hesitation in leaving these two choir masters in charge.

Chairman GLENN. Well, thank you.

Senator HATFIELD. Thank you, Senator Heinz.

Chairman GLENN. I was making a statement more than I was asking a question, I was just adding to what Mark had said earlier. I think that maybe this effort with S. 1951 can be an example of what some of the states can do also to make their dollars go farther. So I am all for this, obviously, and I appreciate you being here this morning.

Senator HATFIELD. Thank you very much, Mr. Chairman.

Chairman GLENN. Thank you. Our next panel this morning includes: Dr. Thomas Ratchford, Associate Director, Office of Science and Technology Policy; who is accompanied by Dr. Luther Williams, Senior Science Advisor of the National Science Foundation; Mr. Christopher Cross, Assistant Secretary, Office of Educational Research and Improvement, Department of Education; and Dr. Richard Stephens, Director. University and Industry Division, Office of Field Operations and Management, Office of Energy Research, of the Department of Energy.

We welcome all of you to the panel this morning, and Dr. Ratchford, if you will lead we would appreciate it.

I understand, Dr. Williams, that you may have to leave by 10:40 to address the National Science Board this morning; is that correct?

Dr. WILLIAMS. Yes.

Chairman GLENN. We will let Dr. Ratchford lead off, and I think we will have time to get everybody's comments in before you leave. Dr. Ratchford, thank you very much.

TESTIMONY OF J. THOMAS RATCHFORD, Ph.D., ASSOCIATE DIRECTOR, OFFICE OF SCIENCE AND TECHNOLOGY POLICY;[1] ACCOMPANIED BY LUTHER WILLIAMS, Ph.D., SENIOR SCIENCE ADVISOR, NATIONAL SCIENCE FOUNDATION; CHRISTOPHER T. CROSS, Ph.D., ASSISTANT SECRETARY, OFFICE OF EDUCATIONAL RESEARCH AND IMPROVEMENT, DEPARTMENT OF EDUCATION; AND RICHARD E. STEPHENS, Ph.D., DIRECTOR, UNIVERSITY AND INDUSTRY DIVISION, OFFICE OF FIELD OPERATIONS AND MANAGEMENT, OFFICE OF ENERGY RESEARCH, DEPARTMENT OF ENERGY

Dr. RATCHFORD. Thank you very much, Mr. Chairman. I shall be brief. I am pleased to be here today to discuss the issue of interagency coordination in science and mathematics education. This Committee is to be commended for its interest in addressing the science and mathematics education challenge facing this country. Clearly, all of us have to work together to meet this challenge and to solve the problems that we face.

I am accompanied today by Dr. Luther Williams, the Assistant Director for Education and Human Resources at NSF, Dr. Christopher Cross, Assistant Secretary for Educational Research and Improvement at the Department of Education, and Dr. Richard Stephens, Director of University and Science Education at the Department of Energy.

The problems this Nation faces in science and mathematics are well documented. The state of science and mathematics learning among our children, youth, and college-age adults is very disturbing. Dr. Bromley, the Assistant to the President for Science and Technology and Director of the OSTP, has stated on numerous occasions that unless we make fundamental changes in our educational system, the United States faces the prospect of a decline in its international standing.

The President and this Administration are fully aware of the problems that we face in this area and have made significant strides in addressing the issue. As you know, the Education Summit held by the President and the Nation's Governors led to a set of National Education Goals and objectives to be reached by the year 2000. Science and mathematics learning are central to those goals, which include the following: By the year 2000, American students will leave grades 4, 8 and 12 having demonstrated competency in challenging subject matter, including English, mathematics, science, history and geography. The other goal that is quite relevant to our discussions this morning is that by the year 2000 U.S. students will be first in the world in science and mathematics achievement.

These goals form a national framework for Federal policy and strategic investments in science, mathematics, technological and engineering education at all levels. However, to achieve these

[1] See p. 55 for Dr. Ratchford's prepared statement.

goals, it will be necessary for all concerned parties to work together. Our teachers, students, industry, academia, state and local governments and the Federal Government, Congress and the Executive Branch, all have important and varied roles to play.

Through the fiscal year 1991 budget, the President has placed high priority on programs and funding for science and mathematics education. The fiscal year 1991 budget proposes over $1 billion in direct spending in 5 agencies for science, mathematics and engineering education, an increase of 26 percent above fiscal year 1990. These programs are designed to advance general scientific literacy and mathematics numeracy and to prepare the next generation of scientists, engineers and technicians.

The Department of Education and the National Science Foundation have substantial programmatic responsibility for science, mathematics and engineering education, with critical supplementary roles played by the Department of Energy, the National Aeronautics and Space Administration, and the National Institutes of Health. Other agencies play important supporting roles as well.

Mr. Chairman, my prepared statement describes some of the programmatic responsibilities and budget initiatives by these agencies. With your permission, I will submit that portion for the records and move on to consideration of your main concerns, namely the coordination of Federal science and mathematics initiatives.

Chairman GLENN. Good. Your entire statement will be included in the record.

Dr. RATCHFORD. OSTP is committed to developing and maintaining a well coordinated interagency Federal program in support of science and mathematics education. The department and agency programs which are described in my prepared statement collectively represent some of the Administration's initial efforts to assist states and local communities in achievement of the national goals developed by the President and the Governors. The effects of these programs will be limited, however, unless they are closely coordinated across agency lines and unless they work in concert with reforms in the states, local school districts, and schools, colleges and universities.

Dr. Bromley has committed OSTP to maintain a well-coordinated Federal policy and programmatic presence in support of school and college opportunities and reforms. We plan to achieve this coordination through the new Committee on Education and Human Resources within the Federal Coordinating Council for Science, Engineering and Technology, with the delightful acronym, as you noted earlier, FCCSET.

The newly revitalized and reorganized FCCSET is charged with reviewing and coordinating science, engineering and technology activities that affect more than one Federal agency. FCCSET, which is comprised primarily of Cabinet secretaries and heads of independent agencies, has established seven umbrella committees in the areas of earth and environmental sciences; education and human resources; food, agriculture and forest research; international science, engineering, and technology; life sciences and health; physical, mathematical, and engineering sciences; and technology and industry. Our intention is to cover a broad range of issues in science and technology. In turn, FCCSET will provide

input to the President's Cabinet (councils, such as the Domestic Policy Council the Economic Policy Council, on major policy issues that contain substantial elements of science and technology.

The new FCCSET Committee on Education and Human Resources, as you noted earlier and as referred to by Senator Hatfield, is chaired by Secretary of Energy James Watkins, with the Under Secretary of Education, Ted Sanders, and the Assistant Director for Education and Human Resources of NSF, Luther Williams, serving as vice chairs. The Committee will coordinate, on a continuing basis, activities of the Federal agencies related to science, mathematics, engineering and technological education, training, and human resource development, in coordination with existing President's Cabinet Council working groups such as the DPC Working Group on Education, chaired by Secretary Cavazos, and the DPC/EPC Working Group on Science and Technology chaired by Dr. Bromley.

The Committee's work will promote more efficient use of the expertise that exists in the agencies, avoid needless duplication, identify areas of new program opportunities, and make more efficient use of limited Federal resources. The objective of this new FCCSET Committee is to develop a truly integrated interagency effort in strengthening science, mathematics, engineering, and technology education at all levels, and in developing and maintaining a technologically and scientifically literate work force to keep the nation competitive in global markets.

The members of the FCCSET Committee on Education and Human Resources will include senior policy-level officials from all Federal agencies with significant responsibilities in the area of science, mathematics, engineering and technological education, including those with jurisdiction over the education of scientists, mathematicans and engineers, as well as those with responsibilities for technician training and science literacy for the general public. The Committee will also include those agencies that are major users of scientific and engineering personnel.

The agencies that are potential members of the FCCSET Committee on Education and Human Resources include the Departments of Agriculture, Commerce, Defense, Education, Energy, Health and Human Services, Interior, Justice, Labor, and Transportation, as well as Veterans Affairs, the Environmental Protection Agency, NASA, the National Science Foundation, and the Smithsonian Institution. The Office of Management and Budget, the Office of Science and Technology Policy, and the Office of Policy Development, all in the White House, serve as ex officio members. The Committee charter and membership will be completed and approved very shortly.

However, given the urgency attending mathematics and science education, for several months I have chaired an interagency group composed of the principal agencies involved in science and mathematics education to address issues requiring immediate attention. Substantial progress has been made in understanding agency programs, identifying areas of complementary program priorities, and encouraging joint funding initiatives. As a subset of this more broadly based interagency effort, OSTP has worked closely with the Department of Education and the National Science Foundation

to improve coordination of science, mathematics, and engineering education programs between those two important agencies. OSTP's March 1, 1990 report to the Senate Appropriations Committee, referred to earlier this morning, on Department of Education and NSF coordination is provided as an attachment for the record.

In that report, we noted that the Secretary of Education, Dr. Cavazos, and the Director of the NSF, Mr. Bloch, have established formal mechanisms for coordination of science and mathematics education programs between the two agencies. The Director of NSF appointed Luther Williams to chair the coordination effort on behalf of that agency. Christopher Cross has been charged with heading the coordination effort for the Department of Education. Coordination at all appropriate levels between the Department of Education and the NSF is the continuing responsibility of these high level officials.

Initial results of these coordination efforts have been excellent. For example, the Department of Education has initiated dissemination efforts with the National Science Foundation and others whereby the Department's clearinghouses, regional laboratories, and the National Diffusion Network will provide states and localities with timely knowledge about exemplary materials and practices. In addition, the Department of Education and NSF are discussing a special Upward Bound initiative to provide minority high school students with opportunities similar to those provided by the NSF Regional Career Access Centers. Another noteworthy example of the enhanced coordination between Education and the NSF is the commitment of the Department to promote the availability of its Eisenhower Act mathematics and science funds for use in conjunction with the recently announced NSF-sponsored Statewide Systemic Initiative.

The bill the Committee is considering, S. 1951, would establish an Interagency Committee on Science and Mathematics Education. Such a structure would duplicate the purpose and mission of the FCCSET Committee on Education and Human Resources. It is clear that OSTP, through its enabling legislation, has sufficient authority to establish such an interagency committee. In my judgment, we have exercised that authority in a constructive manner with the establishment of the FCCSET Committee on Education and Human Resources. Considerable progress respecting interagency coordination has been realized in a few short months, and we expect more progress in the weeks and months ahead. Therefore, I believe this legislation to be unnecessary in light of actions already taken or in the pipeline. My colleagues here today, representing Education and Energy and the National Science Foundation, share this view, which, in itself, serves as an example of the coordination and close cooperation underway.

On behalf of my colleagues with me, Mr. Chairman, I would like to express our appreciation for the opportunity to appear before this distinguished Committee, and we would, of course, be happy to address any questions that you might have.

Chairman GLENN. Okay. Good. Thank you very much. I appreciate that, and I appreciate your statement.

The basic difference between what you propose with the FCCSET committee and what we propose with S. 1951 is that S. 1951 would

be permanent, the chair would be the Science Advisor, and there would be an independent evaluation by the NAS and a report to Congress. Those are the major differences.

I think what we see as a weakness in FCCSET is that it terminates—it goes out of business. I don't question the commitment of the Administration to the educational goals, but I don't know how we can pursue these goals through this Administration and into the next administration and the next and the next and the next without a permanent coordinating committee. And I think it is a problem that is going to go on that long. So that is the reason we have favored the approach taken in S. 1951.

Let me say that to meet this goal of being number one in science and math by the end of this decade is a very ambitious goal. I share that goal with the President and all of you, but we have a lot of those kids already in school right now. They are there. They are in the pipeline right now. And to make us number one in science and education in that short a period of time is going to require a far greater commitment of money and resources and effort and organization if we are to meet that goal and not just toss it out as some kind of rhetoric.

It doesn't do much good to just toss out a goal unless we have a realistic hope of attaining that goal. And with the current level of funding, just to go along and say, well, we are going to stress this and it is going to happen all by itself—it isn't going to happen!

I don't know whether you have any comment, or anyone else has a comment, on this or not. How are we going to make it happen by the year 2000?

Dr. RATCHFORD. That is a very challenging goal, Mr. Chairman, as you have pointed out. First, let me point out that this goal is not just a goal of the President, it is a joint goal of the President and the Governors. And if one looks at the distribution of funding for education in this country, it is clear that the states and the localities are going to have extremely important roles to play. This doesn't say that the Federal Government doesn't have an important role as well, and we are, in fact, attempting, through a working group of the new FCCSET Committee, to address some of these issues.

It would perhaps be appropriate at this time to ask Dr. Williams, who chairs this particular working group, to comment on what they are doing and also would permit him to make his comments in time for him to leave as his schedule requires.

Chairman GLENN. Fine. Dr. Williams, how are we going to make it happen before the year 2000?

Dr. WILLIAMS. As you have indicated, Senator, it is an exceedingly challenging goal and, quite frankly, it is going to be very difficult. In my view it is not going to occur without engaging, quite frankly, in a different context all of the resources of the nation—local, state, as well as the Federal sector. And that's why I think the efforts that have been initiated in the Federal sector are so important.

Leaving aside the level of the resources, it seems to me the critical issue right now is to ensure that the Federal sector emerges with a comprehensive plan characterized by three or four indices. One is that there is not rhetoric, as you inferred, but genuine coop-

eration across the various agencies where one can actually measure outcomes, which is integral to that, not simply to talk about the magnitude of the interaction between NSF and Education, or any agency, but do we have explicit goals on a fiscal year by fiscal year basis. Those subgoals, subobjectives, are related to the national goals, and we actually measure them, see what we have accomplished, make mid-course adjustments.

The other subgoals seem to me——

Chairman GLENN. Well, if we are measuring those, would you favor the independent evaluation by NAS and the report to Congress then that we proposed in S. 1951?

Dr. WILLIAMS. That's a possibility. Another thing that occurred to me is that there has been created the President's Council of Advisors on Science and Technology. Those individuals deliberately are drawn outside of the government. They represent the academic sector, government, private industry, a rather diverse group, some of which, quite frankly, would be redundant with the membership of NAS. And that group—Dr. Ratchford can speak more definitively—but that group has identified early on among its several charges education. That group, it seems to me, could be supplemented by others and actually examine the outcomes from the Federal sector effort. But I emphasize that measuring what is achieved with time is important.

With respect to the effort on the budget, we have taken on the responsibility in a fairly short time frame to develop a genuine interagency budget in education, math/science education, math/science, engineering, technology education, for fiscal year 1992, and being familiar with the budget process, you recognize that starting in May to try and have that accomplished in September is no inconsequential task. But we are truly placing on the table all of the programs of every single agency, and two very important things are coming out of that exercise. One, we are identifying the gaps. You made the point with respect that the majority of the youngsters we desire to engage in the talent pool are already in the schools, so we have got to think about this in the pipeline context and identify the gaps if we are really going to be successful. That is going to be one result of this budget exercise, beyond the discrete business of addressing who is spending what.

The second thing is to have efficient use of those monies, and that to ensure that we really cooperate where we must, there is enormous coordination, and we eliminate duplication. Therefore, that will then be a genuine Federal sector math/science education budget. As Senator Hatfield correctly pointed out, that budget, that commitment, those set of activities, have to be effectively integrated with other players in other parts of the society in order to have a truly national effort.

Chairman GLENN. Is there a commitment to putting more money into math and science education? Is it organization as well as money? Do we have a commitment of both from the President and OMB?

Dr. WILLIAMS. I can't answer from the vantage point of the President and OMB, but I can describe what is occurring as the agencies are interacting. There is a commitment in all 3 of the areas. One of the exercises, as I indicated, is identify areas where there are gaps,

where there are needs. Second is to, in the coordination exercise, better use the resources that are available.

Chairman GLENN. Well, I will get to a couple of questions for you since you have to leave shortly. NSF is reorganizing its Science Education Directorate and you were recently named Director of the newly named Education and Human Resources Directorate. Can you give us any details on how that is going to strengthen the science programs at NSF?

Dr. WILLIAMS. I think it would strengthen them substantially. As you know, the National Science Foundation historically has dealt with the total pipeline with respect to math/science education. There are four discrete levels. They have a total set of programs in the precollege area that goes from K–1 through 12th grade. It covers essentially every set of activities you would imagine, from teacher preparation, improving the preparation of teachers already in the work force, curriculum material, educational technologies, students, et cetera. That is one component, the precollege arena.

Second, we have a major commitment to undergraduate math, science, engineering education. The generic part, the general part of that resides in this directorate for which I have responsibility.

Chairman GLENN. But those programs are there now.

Dr. WILLIAMS. Those programs are there now.

Chairman GLENN. Well then what are we going to do in addition to that, because everything is not working out like we thought it was going to do; how are we going to correct it?

Dr. WILLIAMS. Well, that is what I am approaching. There are also, as you know, research directorates at NSF that have primarily the responsibility for research, but those research directors are devoted to engineering, computer science and information engineering, to biology, the behavioral sciences. Those programs support undergraduate education in a discipline-specific mode, meaning there is now going to be in the new structure an explicit collaboration between our division and the engineers to deliver a holo-engineering undergraduate education program. That is a very important, I think, within the context of the Foundation, explicit coordination to ensure that the final result for the Foundation is a more efficient effort at the undergraduate level, which is presently characterized as something other than very exemplary.

I mean, quite frankly, if you look at the graduate level in science and engineering, we are drawing primarily on other countries to produce the undergraduate outcomes. So part of the reorganization was to address that issue and have efficient coordination. The point is this, we have 7 directorates. What the Foundation needs is one substantial, well-coordinated math, science, engineering education program. That was the goal. Not terribly different, in a way, than what needs to happen in the interagency coordination.

The last point that it is important in terms of the pipeline at NSF, we have a major commitment in terms of graduate education and initial career development. The notion is to bring to bear all of the NSF resources, programs, organizational details so that we have a full-fledged continuum.

Chairman GLENN. My time is up. Senator Akaka.

Senator AKAKA. Thank you very much, Mr. Chairman. I would like to have my full statement included in the record.

Chairman GLENN. It will be included in the record.

OPENING STATEMENT OF SENATOR AKAKA

Senator AKAKA. I would like to commend you, Mr. Chairman, and Senator Hatfield, for your leadership in this field. The scientific and mathematical community are extremely concerned about the shrinking pool of qualified American students going into these areas. Initiatives like S. 1951 will provide the necessary coordination and direction to our science and math educational programs.

Chairman GLENN. Just one second, if I might.

Dr. Williams, we might want you to respond in writing to additional questions if you will. They will be included in the record from other members as we review the record here, and we would appreciate your response to those.

Thank you. The same goes for all of you this morning here.

Senator AKAKA. Mr. Chairman, report after report shows that the United States lags behind other industrialized countries in math and science. We are finding it increasingly difficult to compete with the technological advancements occurring around the world. At the recent National Educational Conference, the President and our Governors established a goal to make American students the first in the world in science and mathematics achievements by the year 2000. There is much to be done, as we all know, if we hope to reach this goal, and S. 1951 should be the foundation on which we build.

If the Nation's goal is to ensure every American student is science and math literate, we will need an interagency council that will be specifically dedicated to the achievement of this goal well into the next decade. We will also need the finances to support this effort, and the Department of Education's 1991 budget calls for substantial increases in funding for programs directly focused on science and mathematics education.

Mr. Chairman, once again let me thank you for your commitment to this problem. I appreciate this opportunity to share my concerns and look forward to working with you on this.

[The prepared statement of Senator Akaka follows:]

PREPARED STATEMENT OF SENATOR AKAKA

Mr. Chairman, I would like to commend you and Senator Hatfield for your leadership in this field. The scientific and mathematical community are extremely concerned about the shrinking pool of qualified Americans students going into these areas. Initiatives like S. 1951 will provide necessary coordination and direction to our science and math educational programs.

Mr. Chairman, we are here today to consider a bill which could have a profound effect on our future competitiveness. S. 1951, the Interagency Council on Science and Math Education, introduced by our colleague, Senator Mark Hatfield, would coordinate federal science and math education programs in existence today, on which we spend a billion dollars.

Report after report shows that the United States lags behind other industrialized countries in math and science. Little wonder that we are finding it increasingly difficult to compete in the technological advancements occurring around the world.

At the recent National Educational Summit, the President and our Governors established a goal to make American students the first in the world in science and mathematics achievement by the year 2000. There is much to be done if we hope to reach this goal, and S. 1951 should be the foundation on which we build.

As you know, the National Science Foundation (NSF) was established to ensure the scientific, engineering and technological well-being of this country. Other feder-

al agencies, however, also have a keen interest in advancing our scientific and technological standing. The Departments of Defense and Energy, the National Institutes of Health (NIH), and the National Aeronautics and Space Administration (NASA), to name a few, are all deeply concerned about the scientific and technological position of the United States.

Only recently have efforts been made to coordinate the science and math programs conducted by various federal agencies. The Office of Science and Technology Policy (OSTP), directed by Dr. Allan Bromley, assistant to the President for Science and Technology, established FCCSET, the Federal Coordinating Council for Science, Engineering, and Technology.

The purpose of this new federal interagency program is to review and coordinate the science, engineering and technological activities that involve more than one federal agency. It would seem that S. 1951 duplicates this effort; however, this is not totally true.

The bill would require the council to identify, review, and coordinate science, mathematics, and technology education programs and activities of *each* member agency. The council would also be a permanent entity, while FCCSET's charter expires in 1992. If the Nation's goal is to ensure every American student is science and math literate, we will need a interagency council that will be specifically dedicated to the achievement of this goal well into the next decade.

Mr. Chairman, duplication is not the intent here. Unfortunately, FCCSET is inadequate as it stands. Therefore, S. 1951 is required to define clearly the objectives of the interagency council and provide continuity for coordination between federal agencies.

Mr. Chairman, once again, let me thank you for your commitment to this problem. I appreciate this opportunity to share my concerns, and look forward to the passage of this legislation.

Chairman GLENN. Thank you. If you have any questions, go right ahead, if you would.

Senator AKAKA. Yes, Mr. Chairman. The Department of Education has included in its fiscal year 1991 budget substantial increases for science and mathematics. In your statement, Mr. Ratchford, you stated that the budget calls for a $500 million increase in Chapter 1 funding, a portion of which will be used by local school districts for remedial mathematics education.

Would you make further comment on this point?

Dr. RATCHFORD. With your permission, Senator, I would like to ask the Assistant Secretary of Education, who is accompanying us here today, Dr. Christopher Cross, to respond.

Senator AKAKA. Thank you.

Dr. CROSS. Senator, good morning. As you have noted, the Department's budget has a 70 percent increase in it for the Eisenhower math/science program. That is the most important and the single largest source of Federal funding in the mathematics and science area. If the President's budget request is granted for next year, it will bring the funding of that program to about $230 million.

Now, most of that money goes out to the States under formula grant, and then the States are obligated to use that in the promotion of these programs. In addition, about 10 percent of it is retained at the Federal level for us to fund programs of national significance, programs which are administered by my office.

We are doing things in that area, for example, such as working with the American Association for the Advancement of Science to help them in promoting Project 2061, which is their new science curriculum attempt to upgrade and to substantially enhance science teaching.

We also have been working and will be working with the Mathematics Science Education Board in their attempts to upgrade the

curriculum in mathematics. We have been coordinating on both of those projects with the National Science Foundation, as well as working with NSF on a number of other issues, including what NSF refers to as informal science, which is primarily the use of public television. And also NSF is working with us in the support of the research centers which we fund in math and science education.

With your permission, I have with me a copy of the report which the Department submitted several weeks ago to the Congress on coordination between NSF and the Education Department that has more specific detail in it around the kinds of programs that are in both agencies, and I would like to, Senator Glenn, submit that for the record.[1]

Chairman GLENN. Without objection it is so ordered.

Senator AKAKA. When these funds become available, it is noted that they will be used by local school districts for remedial mathematics education, is this true?

Dr. CROSS. Under Chapter 1, yes.

Senator AKAKA. Would there be any alternative instructions or methods suggested to these school districts?

Dr. CROSS. Yes, as you say Senator, under Chapter 1, one of the major things that is involved there is improving particularly in the mathematics area in the lower schools, and then mathematics and science both in the upper grades. Under the National Diffusion Network, which we operate as a way to bring to the attention of school districts exemplary programs, we in fact have through that program a number of specific exemplary programs in teaching math and science at the elementary and secondary school levels which are made available to schools to give them some exemplary ways to do that.

In addition, we provide a wide variety of other information to states and local districts. We operate 2 clearinghouses in math and science education, the research centers, which I mentioned earlier, and we try to do as much as we can to make available to school districts ideas about how they can provide this kind of education at the local level.

Senator AKAKA. I wasn't here the entire time, could you summarize your response on S. 1951, which provides an Interagency Council on Science and Math to coordinate Federal science and math education programs in existence today?

Dr. RATCHFORD. I would be happy to do that if I might, Senator. The summary of my prepared statement in that regard was that we agree completely with the Committee on the need for effective coordination and have taken steps to do this through the Committee on Education and Human Resources of the Federal Coordinating Council on Science, Engineering and Technology. That Committee and the interagency group proposed in this legislation are quite similar.

There are, as the Chairman pointed out, a couple of significant differences and, in fact, if I could take a few seconds, I can address those as well. I would like to do so in the context of the overall

[1] See p. 80.

philosophy that Dr. Bromley and the President bring to the rejuvenation of the FCCSET process. This Federal council has seven committees, of which the Committee on Education and Human Resources is one.

First, let me point out that the council is permanent. It is established by the organic act that established OSTP, and it is permanent. The committees—and there was a lot of discussion during the meetings of the full council—the committees have all been given 2-year lifetimes. That 2-year lifetime is explicitly put forward with the expectation that most or all of them will be retained, but that it is appropriate after a 2-year period to review the terms of reference, the charter, if you like, the responsibilities, the objectives of each of the committees.

So the committee is not a temporary one. It is one that would be reviewed after 2 years and, in this case, certainly would be continued, perhaps with a different charter, perhaps with a few different terms of reference, but certainly continued.

The other major difference, as the Chairman pointed out, is the chairmanship of the committee. Here, again, let me say just a word or two about how FCCSET functioned in the past before Dr. Bromley came to the White House. Many of the FCCSET committees in the past were chaired by OSTP associate directors or assistant directors and were participated in by the agencies. A fundamental decision was made that it is not wise for the OSTP to be involved in an operational sense in the various committees. There are so many of them and we have so few staff and Dr. Bromley is spread so thin, that in making these tradeoffs, the decision was made that all of the committees should be chaired by an appropriate leader from one of the agencies; that in most, if not all, cases there should be one or two vice chairmen from different agencies. In the absence of the chairman, it is the vice chairman, not someone from the same agency, that participates, so that there are efforts to keep any one of the committees from being, in a sense, captured by a single agency.

Our feeling is that for these committees, including the Committee on Education and Human Resources, to be effective it has to be a true interagency effort, one that is in fact participated in by all of the major players. This does not mean that OSTP will not play a role. We will play a role, but what we have thought important is to avoid as many of the administrative and operational responsibilities in the full FCCSET and in the various committees as possible.

I hope that will be helpful in explaining some of the rationale behind the current structure.

Senator AKAKA. Dr. Ratchford, I understand that there were problems in coordination between DOE and NSF. Although OSTP seems to have duplicate roles, this bill can make a difference in the coordination effort for science and mathematics. Knowing this, could the bill resolve some of the problems in coordination?

Dr. RATCHFORD. I would like to ask Dr. Cross to address this, but first let me say that it was the initiative of the Senate Appropriations Committee that led us to carry out, with the Department of Education and the National Science Foundation, a rather thorough evaluation of existing problems in coordination and how those might be addressed. A report was submitted the 1st of March this

year outlining how we plan to approach it, and a lot has happened since then, and I would ask Dr. Cross, if he would, to address that.

Dr. CROSS. Senator, I think that it is true in the past there certainly was not the level of coordination and cooperation between the two agencies that one would have asked for. I think the philosophy this Administration brings of really close collaboration and coordination between agencies has made a major difference here. And I would make the same comment with respect to S. 1951 in establishing by law what is now established by administrative action. It doesn't matter what is in the law if you don't have the will and the people involved who really are committed to making things happen. We all could cite an arm's length list of laws on the books that are not really attended to or are basically given lip service and just exist. And I think the important issue is not whether it is in the law or it is done administratively, it is that you have people who are really committed to the goals, committed to seeing things happen, and will work together.

This has been the case with respect to the Foundation and the Department of Education for the last year or so. We have had excellent working relationships. This document which I asked to be put in the record earlier details this in greater detail, but more importantly I think is the kind of working relationships that exist between people. I am sorry that Luther had to leave to go to the Science Board, because I think that he could speak as well as I about the kind of close working relationships that we have developed, and it has flowed down from us to the staffs in the two agencies, so that we have a situation here which is far different than existed in the past. And it is not only the kind of working relationship that exists between Dr. Williams and myself, it is the kinds of activities that are going on at all levels of the agency that have keyed from the kind of commitment that exists at the top parts of the agency.

Senator AKAKA. It troubles me to hear you admit that agencies choose not to carry out the law. I have had similar experiences with other agencies.

Dr. CROSS. Perhaps I am too candid.

Senator AKAKA. I want you to know that I am troubled, and I hope this bill will begin to move agencies in the right direction.

Thank you, Mr. Chairman.

Chairman GLENN. Thank you very much. One of the most serious problems is our laboratory facilities. There have been estimates as high as $10 billion a year to address the poor conditions in the Nation's laboratories. If we are really going to have a first class science education program in this country, we have to take the steps to modernize these labs.

Now, that means if we are going to have any effect and doing anything before the end of this century, it is going to have to make an impact in the next 5 or 6 years. That's a couple of billion a year.

Do you have a feeling that the Administration is willing to put $2 billion a year into lab facilities, or are we going to limp along on this one billion here and a few bucks there and wring our hands and talk about it? And we are not going to be competitive very long in the international marketplace if we don't have the people. And yet I don't see a commitment in the present budget environment that we are operating in to really do that much about it. Now

we find out we are not even going to have the budget submitted until 1992.

Dr. RATCHFORD. That's next fiscal year, Mr. Chairman.

Chairman GLENN. Yes, I know, but I wish we had it today so we could start working on it.

Is the commitment there? For instance, do you think it needs $10 billion for our labs? How are we going to do that?

Dr. RATCHFORD. As I mentioned earlier, and as Dr. Williams said, we are currently engaged in a process of defining what is needed and what the Federal role should be in providing these kinds of facilities. There are, however, some other things that are going on at the present time related to better use of existing laboratory facilities in our mission agencies.

Chairman GLENN. And that is what you try to address with FCCSET, and that is what we are addressing with S. 1951, better use of existing facilities.

Dr. RATCHFORD. That's right. The Department of Energy is one of the agencies that has given special thought and attention to this, and with your permission, Mr. Chairman, I would like to ask Dr. Stephens to address some of the specifics that the Department of Energy is attempting in this area.

Chairman GLENN. Let me just say before you start, Dr. Stephens, nobody is a bigger admirer of your boss over there than I am. We have worked very closely with him on some of our nuclear problems, such as the nuclear complex cleanup. I traveled with him the other day out to Ohio. I know of his absolute unequivocal dedication to this area of science education. He thinks it is critical for this country. It is no criticism of him that S. 1951 requires the President's Science Advisor to be chairman. I would probably be happy—if I knew he was going to be the head of DOE for the 15 years.

Dr. STEPHENS. Well thank you, Mr. Chairman, I will certainly pass those words back to Admiral Watkins. He has certainly over his career made a visceral commitment to science and math education improvement. And I must then take a somewhat slight demurral from one of your opening statements. He has actually translated that visceral personal commitment into an institutional commitment on the Department of Energy's part to do more in science and math education. As a matter of fact——

Chairman GLENN. I know that, but our question is, should the Department of Energy be the lead agency in this area, mainly just because he is there? Another Department of Energy Secretary might not have that same kind of commitment or background that leads him in that direction. What we are trying to establish is something that is sort of apolitical. It is something that will go on whatever administration is in and whoever is in a particular job. That was our purpose.

Dr. STEPHENS. I understand, Mr. Chairman, and certainly insofar as the Department of Energy is concerned, the Secretary has made an institutional commitment. On May 21st, for example, he issued what we essentially call an executive order in the Department, or affectionately called a "Watkinsgram," establishing support for science and math education as a Department commitment. And I have provided previously to the Committee a copy of this executive

order, or Secretarial notice. But with your permission I would like to read at least one sentence from it to show you this type of support: "It is my intention to utilize fully the significant resources of the Department, its Federal and contractor employees, and its national laboratories and research facilities, to assist in the critically important national effort to strengthen and improve mathematics and science education fundamental to the production of qualified mathematicians, scientists, engineers, and technicians."

This policy statement now pervades the entire Department of Energy from the individual level to the program level to the national laboratory level. And as Dr. Ratchford indicated, perhaps the most unique contribution that our Department can make to science and math education improvement is bringing faculty members, teachers, and students into our national facilities for hands-on research experiences.

As you indicated, Mr. Chairman, the best way probably to learn science is to do science, and that's one thing we think we can do a good job at, is to expose our young people and our teachers to first class, world class science. We bring in thousands of scientists and engineers every year to the Department's facility. We bring in high school science students from every state in the country. We bring in high school science teachers from every State in the country to spend the summer working with our scientists and engineers in actual research.

Now, in terms of total dollar investment, certainly the Department of Energy is not a major funder of science education. But we can and will make a difference in individual careers, and that is indeed what the Admiral has made a commitment to. So I am pleased to represent him on this panel and certainly indicate that he will be an active, aggressive, vigorous FCCSET chairman on the Education and Human Resources Committee. This Secretary has no low gear, he is always on overdrive, and I think you will see that in this particular effort.

Chairman GLENN. Thank you very much. And I agree, I think that is a great program that he has established for visiting the labs. But all the high schools don't have a national lab next door for the kids to visit. That's the big problem. And I think where we have something like—somebody correct me if I'm wrong—16,000 school districts in the United States. I don't know what that translates into in high schools, but I suppose the number of high schools would be greater than that. I applaud the national labs' effort and want them to remain in that role, but that isn't going to solve our over all program.

Do we have any way of evaluating our systems now? S. 1951 would require the National Academy of Science to evaluate the effectiveness of Federal science education programs. What kind of evaluation is being done now and what is the Administration's position on that? Do you favor that or are you against that, NAS doing an effectiveness evaluation?

Dr. CROSS. I could speak for the Department of Education, Senator. We have an ongoing series of evaluations. For example, the Eisenhower Math/Science Program is currently being evaluated by an outside firm to determine what the effectiveness of that program is and to document some of the activities going on. That eval-

uation will be available in another few months. We are very committed to evaluation and to reflecting the results of those evaluations into improvements in the program.

I think there is no question that one has to do that, and I note as well that, in looking at S. 1951, you also asked for the Academy to gauge the effectiveness of dissemination of programs. And that is also something that I think is vitally important and very much needs to be done. But I think the agencies engage in that as a regular practice.

Dr. RATCHFORD. Evaluation, of course, Mr. Chairman, is a crucial part of the entire process of attaining the goals that the President and the Governors have enunciated. We are all aware of the National Assessment of Educational Progress effort which, within the Federal Government, the Department of Education has the major responsibility for. It is, however, I think quite clear that we will face a number of challenges in the coming years to better design evaluation instruments, not only for the individual programs, but what is even more important, the results of those programs affecting our youth in our schools.

Chairman GLENN. Do you think we can do this without major increases in the budget? Can we accomplish our goals without very major substantial increases in budget?

Dr. RATCHFORD. For the evaluation budget or for the total budget?

Chairman GLENN. No, I am just talking about in general, in this whole area of math/science education.

Dr. RATCHFORD. There certainly will need to be more effective use of funds than we have at the present time. I was struck by the comparison that Senator Hatfield gave, 30/30/40 distribution of funds within the school system that he was referring to.

Chairman GLENN. But the question is can we do it without a lot more money. I come back to the question.

Do any of you want to comment on that?

Dr. CROSS. Yes, Senator, I will stick my neck out and give you an answer on it. I think that in fact it will require some more money, but more important is the restructuring of education that needs to go on. There are a number of elements to that, projects such as the one I referred to earlier being undertaken by AAAS and the Mathematics Science Education Board, things such as doing more to improve the quality of teachers in the schools relative to their competencies in these subject matter areas.

As you may know, one of the proposals that the President has put forth is alternate teacher certification. We have out there a great number of people who have been trained as scientists, as mathematicians, as engineers, who we frankly are going to be faced with—if you will forgive us a term from the space program—retrofitting them, in a way, as we look to the downsizing of the military, as we look to the aerospace industry in terms of them actually going through some significant layoffs in that industry. A week ago I met in Los Angeles with a group of aerospace executives from the industrial sector out there. They are very concerned about what is going to happen with respect to the people who they are going to no longer require.

Many of them again are highly trained. If we can find ways to get some of those people into the classrooms through things like alternate teacher certification, we can do a heck of a lot to enhance science and mathematics teaching and remove from those teaching assignments the people who are, frankly, not trained as well as they need to be in this area.

I would commend to your attention a report done by the Council of Chief State School Officers several months ago that went state by state and looked at the percentage of teachers in these and some other areas that were teaching out of field. They were never qualified to teach in these fields, but they are doing it because the principals, superintendents, have to have people. In some states it ranges up to 49 percent in specific fields.

Chairman GLENN. What are we doing in the way of education research? Are we doing much in that area? Shouldn't we increase that area too? I have always been just absolutely astounded, ever since the days when my own kids were growing up, at the rate of learning between about 2 and 7. And then something happens and nobody seems to know whether it is genetic or whether it is just the way human beings develop. Or whether there is something in our educational system that sort of kills off this rate of learning just by dampening the kids. Is there research going on in this area?

Let me just give a little background. I have two little grandsons, 5 and 7, and they just visited us for a week. And I am amazed at some of these things. You know, a little 7 year old in the first grade and, obviously, being my grandson he is a pretty sharp little kid, you understand. But things like how many ways can you get to 30? Well, 6 times 5 gets to 30, and 5 times 6 gets to 30, and 15 plus 15 gets to 30, and 20 plus 10 gets to 30, and on and on and on. And so we count and I get up to two hands and we start over again. There are that many ways of getting to 30, and pretty soon I am out of gas and he is too.

But this is first grade. Now, what on earth happens? The question is, are we doing research. When kids get up to about the 6th or 7th grade, you can't force them into math class and in high school, they don't want to learn it. What happens between the first grade and the twelfth?

Dr. CROSS. I think a lot of things happen. Let me answer it in several areas. First, the area of research is something we are doing some work in, and I would be glad to supply for the record for you some information about the kinds of work we have ongoing in these areas and education research aimed at mathematics and science, and other areas that I think might be of interest to you.

Frankly, one of the issues is that the Administration—and I would say this goes back over several administrations, over both political parties—have had a heck of a time getting the Congress to make the commitment to educational research that it needs to, because the money goes into formula grant programs that go out to the states in small amounts without the focusing of a critical mass to do the kind of research which you are talking about. I couldn't agree more with you, and I would hope that you would see fit when our appropriations comes forward to also look at it with that in mind, because——

Chairman GLENN. You are preaching to the choir here. I don't think there is an education program I haven't voted for since I have been here. I think it is that critical for the future.

Dr. CROSS. Well, let me send you some information here.[1]

Chairman GLENN. I would welcome it.

Dr. CROSS. But I think in terms of your question about what happens, it is a number of things that happen. One of the things is that families get more disconnected from what is going on in the schools as the child gets older, and the teachers at the level of the first grade where your grandson is are fully in charge and they know the curriculum and what goes on in that classroom and they are able to keep ahead and to master. As the students go on you get back to part of the phenomenon I mentioned earlier where teachers are sometimes teaching in areas they are not totally familiar with. Elementary school teachers are not generally trained to be mathematicians or scientists, so they often become uncomfortable with teaching in great depth in these areas, and that gets reflected in the children. The children begin to be adverse to these areas because the teachers sometimes have a hard time making it exciting, making it interesting, and making it stimulating for them.

Chairman GLENN. Why are foreign countries doing such a better job in this particular area than we are, according to international testing scores anyway? Is it mainly societal? Is it that families spend more time with the—

Dr. CROSS. The familial involvement, Senator, is amazingly different.

Chairman GLENN. We are heading all in the wrong direction in this country.

Dr. CROSS. That's right, we are. I have told this story before, but there is some research done by a Professor Stevenson—I have forgotten the university he is associated with now—who did a study of Asian and Caucasian mothers. Have you heard about this?

Chairman GLENN. It may be the same one, I don't know. Go ahead.

Dr. CROSS. OK. Basically asking the Asian mothers what they felt was the most important element in their children succeeding in school. The Asian mothers said it was effort; the Caucasian mothers said it was ability. And I think when you think about that, the words sound very similar, so what's the difference. But when you think about how that gets translated into what happens and the support structure that exists there in the Asian family, for example, to helping the student achieve—I had lunch the other day with a friend who is an editor at the Washington Post, and was saying he likens what has happened in American education to essentially the kibbutz movement in Israel where children are being turned over to the schools to be raised by the schools. And we are not accepting the kind of responsibility that needs to go with families, that need to go with the society, the communities in general, to look into these issues. We have proposed a new research center

[1]See p. 96.

for next year on community, families and children to look exactly at some of these sorts of issues.

Chairman GLENN. I saw on TV a couple of mornings ago that something like by the year 2000 70 percent of preschool children will be in homes where there is a working mother and the mother is out during the day—70 percent of preschool.

Dr. CROSS. It is not far from that now.

Chairman GLENN. Close to that?

Dr. CROSS. It is in the 50s I think.

Chairman GLENN. Enormous changes in our society, and maybe that is part of our problem. Do you think the situation Ross Perot found in Texas is the general situation all over the country? Are we spending only 30 percent of our money on good solid academics and 30 percent on soft electives, whatever they may be, and 40 percent on administrative and extracurricular? Is that a pattern that is probably true all over the country?

Dr. CROSS. It is probably not far from true. I couldn't verify the figures exactly, but if you look at the patterns of educational expenditures in say the last score of years, the last two decades, you will find that the percentage of the dollar that goes into the classroom teaching, the person who is in the day to day interface with the student has declined while the percentage of dollars going into other functions, other costs in the schools, has increased. And, frankly, some of it is going into things like paying for all those grants administrators who have to write the grant applications to get the Federal grants. I mean, we are in part responsible for this too. We have created a big bureaucracy in a middle level core there that has outgrown the schools in some cases.

Chairman GLENN. We have a lot of educators who believe that we must restructure the schools. Dr. Bromley, Ernest Boyer, Jim Rutherford of AAAS have called for major restructuring. Now, that is going to take a lot of research if we really are serious about that. Number one, how much will it cost to do that, or even to do the research on it? Do we know?

Dr. CROSS. Well, the research, there is some going on, but certainly much more needs to be done, and we need to evaluate what is going on out there that has already occurred in restructuring. Restructuring really speaks to some things such as is going on in Chicago, the program Kentucky has adopted to begin phasing in this fall. Or one of the things you do is move to something which is called site-based management, trying to get some of the decision-making back into the hands of the principal and the teachers, the parents and the community around a local school, and try to diminish the bureaucratic impact on the school.

That is something I don't think that is so much a cost issue as it is a management issue. Again, what has happened over time is we have tended to more and more centralize decisions. And the school districts have consolidated. The number of school districts, you mentioned, is about 16,000. If you go back 30 or 40 years and it was double that number. What has happened is you have consolidated school districts as you moved the decision-making up higher and higher on the chain and further and further away from communi-

ties. So school-based management restructuring is an attempt to reverse that.

Chairman GLENN. If we restructure—and this is a dynamite question for you—are we going to get away from local control of school districts in the elementary and secondary level? That has been the way our whole system developed up to now, elementary and secondary were pretty much local and state, and much more support for higher education came from the Federal Government, of course. It is just the way things developed more or less.

And as I indicate, I think our support for elementary and secondary schools at the Federal level never got much above 9 percent. And it is 6.1 or 6.2, something like that now. So we are not a major player in that at the Federal level. We provide school lunch programs, inoculations, and various equipment and things like that, but we don't really run the school system of the country and don't try to.

Are we going to come to that, if we are going to correct this problem?

Dr. CROSS. I don't think so. Restructuring really I think will do more to involve more people in running the schools rather than fewer. If you would look at Chicago, for example, again you can look at Miami, look at Kentucky and what is going to occur there, what you are doing is getting more people involved, more parents, more community leaders. And I know you are aware of the extent to which the business community has taken a much greater interest in this. So I don't think you run a risk of losing local control. In fact, I think you will have more of that and more local input into the schools.

Chairman GLENN. We all hear the horror stories from time to time about American students watching TV and they sit glued to the TV for X hours a week, whatever it is, and we always assume that that is bad they do that and don't do some other things. I don't know what the current figures are on that. Asian and European students in the same age category spend far less time watching TV per week. Is there someway we can better utilize TV? All learning is not necessarily within the four walls of the classroom. Can we make better use of this?

Dr. CROSS. I think you can, and in fact I would commend and be glad to send you some information on Korea. The Korean children watch television roughly the same amount as American school children do at the early ages. But the Korean television programs aimed in that block of time when children are most apt to watch, from after school to 7:00 at night or whatever, are almost entirely educational, they are not entertainment, but they are well done educational programs, ones that capture the students' interest and keep them involved.

Chairman GLENN. Is this like Mr. Rodgers or science programs, or things like that?

Dr. CROSS. Yes, right, things like Sesame Street, Square One, 3-2-1 Contact, I mean in our translation.

Chairman GLENN. And in the science and math area what was the program years ago, Mr. Wizard, or something, with the little science experiments?

Dr. CROSS. Yes, Mr. Wizard. He still exists, by the way, on cable television today; he's back.

Chairman GLENN. Really?

Dr. CROSS. Yes, the same man. Don Herbert.

Chairman GLENN. Why can't we get him on the networks?

Dr. CROSS. That's a good question.

Chairman GLENN. Put him out there. I used to watch that just because I thought it was a great program, and once in a while I learned something.

Dr. CROSS. I might mention, Senator, in addition to television, one of the factors that I think at the high school age you have is the degree to which students are working. I saw some figures the other day that in California something like 25 percent of seniors in California high schools worked over 25 hours a week. And the figures nationally are somewhat less than that, but they are still very high. How can we really have high school students who are paying serious attention to their classes when they are working that much? And the data show they are not working to pay for college, they are working for the teenage luxuries, if you will.

Chairman GLENN. Well, we are going to have to move on. I would appreciate your response, all of you, to further questions on this. It is intensely interesting. We are taking one little chunk of it here today with S. 1951 or FCCSET, however we go with that, but we are into such a much bigger thing. And I hope there is the dollar commitment. I know we get into political arguments back and forth all the time, but I would only point out it was Mark Hatfield who sat there a few moments ago and commented about what had happened over the past 10 years as we tried to throw things back to the states. And during that time period was when most of that 9 percent slid down to 6 percent.

I just don't see us getting out of the mire we are in and refurbishing our labs for teaching purposes and upgrading teacher qualifications without some very serious commitments of dollars way, way, way beyond anything that we have seen proposed in budgets so far.

I have talked to Dick Darman about this over at OMB, and I am sure you gentlemen have done some of the same things, but we will continue to work with you, and any suggestions you have, why, send them along to us here, and I hope you could respond to any questions that we submit to you.

Dr. RATCHFORD. Thank you very much, Mr. Chairman.

Chairman GLENN. Our next panel is Sue Kemnitzer, former Executive Director, Task Force on Women, Minorities, and the Handicapped in Science and Technology; and Dr. John Andelin, Assistant Director of the Office of Technology Assessment.

We welcome you, and Ms. Kemnitzer, if you would lead off with your testimony please.

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TESTIMONY OF SUE KEMNITZER, FORMER EXECUTIVE DIRECTOR, TASK FORCE ON WOMEN, MINORITIES, AND THE HANDICAPPED IN SCIENCE AND TECHNOLOGY [1]

Ms. KEMNITZER. Thank you very much, Senator. I appreciate the opportunity to be here today to speak about S. 1951, and also to bring my personal thanks to you for your leadership over the years in this area of math and science education. I recall visiting in the early 1980s to your staff person, Len Weiss, to talk about proposals that you had.

Chairman GLENN. This same Len Weiss who is now the Staff Director of the Committee here.

Ms. KEMNITZER. Yes. During those times when the Federal Government commitment to math and science education was questionable, at least, and I appreciate your being a mainstay at that time, as you continue to be today.

I am the former Executive Director of the Task Force on Women, Minorities and the Handicapped in Science and Technology, and I am here today to speak about interagency coordination. Our group was in a way a precursor to the council idea that is in your legislation, and also to the FCCSET Committee which has been formed. We were an interagency group, established by legislation, I will note, that was sponsored by Senator Hatch back in 1986 out of concern for the decreasing quality and quantity of young people choosing careers in science and engineering, and we have issued two reports, both titled "Changing America," which I would like to leave with you for further reading and consideration.

Chairman GLENN. Thank you, we appreciate it.

Ms. KEMNITZER. One of our recommendations indeed was to set up an ongoing, permanent, interagency group that would continue to review and coordinate Federal efforts in science and mathematics education. And, indeed, when our final report was issued, Dr. Bromley issued a statement of endorsement of that recommendation and a commitment to set up the FCCSET Committee, which he indeed has.

I share with you a very high regard for the people involved in that Committee, and I think that they will be able to bring to bear that old concerted effort that we need to meet the President's goal of being the best in the world in mathematics and science education. But, as you noted, I note that our goal is set on the sight of the year 2000, and indeed, I would say we even need to set our goals beyond the year 2000. And the present leadership of that Committee probably will not be in place at that time, and so I share your concern about the permanency of having a group to coordinate and review these efforts.

Chairman GLENN. Do you think we can meet this goal by 2000, or is that just some semantics for——

Ms. KEMNITZER. Well, I will point out, our report has virtually the same goal as the President's and the Governors, and that is not a coincidence. Hard work on our group's part helped, I think, to shape the goal agenda of those two groups. I believe that if you aim to be number 3, you will probably aim to be number 3, or lower,

[1] See p. 68 for Ms. Kemnitzer's prepared statement.

and my operating philosophy is aim to be number one, otherwise you will never make it. And I sincerely believe that our international competitiveness, national security, and quality of life is very dependent upon having that quantity and quality of science, engineers, and technically competent workers to keep our nation strong.

So yes, I think it is the right goal to have. I think it is going to be hard to achieve, but I am certain that we won't achieve it if we don't set it for ourselves. So my basic point today is to commend what the FCCSET group is doing, but to note that we need a long-term sustained effort which, in my mind, means that you probably need more permanence than the year by year charter process which has been set.

I would also like to say that——

Chairman GLENN. Well, does S. 1951 fill that bill?

Ms. KEMNITZER. As far as I am concerned personally, yes. I would also like to make the point that this bold concerted effort that we need to reach the goal must be one that is undertaken by all segments of our society—parents, teachers, higher education, Governors, et cetera, et cetera. And although the Federal coordination is important and we need to get our own house in order, I would urge the Council or FCCSET group to look toward more lively partnerships with industry and those other segments of our society.

And I will note that I have had very successful working relationships with your Governor, Governor Celeste, who chairs the National Governors' Association Committee on Science and Technology and has been a real leader in pulling together their thinking and commitment. He will be sorely missed in that role when he steps down.

Chairman GLENN. You are probably familiar too with the Edison Program, as they call it back there.

Ms. KEMNITZER. Yes.

Chairman GLENN. That was a very good program. He originated that at the State level. I think some of the money to start it came out of a Federal fund, but it was basically what they originated, and I think that has been a very good program. I wish we had something like that all over the country.

Ms. KEMNITZER. Right. I would hope through the Governors' Association some of those models can be spread. And I would also note that, as Dr. Ratchford mentioned this morning, the President has a science advisory group and the Ohioans have infiltrated that as well. Dr. Healey, Bernadine Healey, is the working chairman of that group and, indeed, has collaborated with our efforts and I know it is a real ally with the things that you and I are trying to do.

So with that, I will close my remarks.

Chairman GLENN. Thank you very much.

Dr. Andelin, any statement you have this morning.

TESTIMONY OF JOHN ANDELIN, Ph.D., ASSISTANT DIRECTOR, OFFICE OF TECHNOLOGY ASSESSMENT, UNITED STATES CONGRESS

Dr. ANDELIN. Thank you, Mr. Chairman. If I might have the formal statement put into the record,[1] I would like to make some alternate remarks.

Chairman GLENN. It will included in the record in its entirety.

Dr. ANDELIN. OTA has examined education, and the education of scientists and engineers in particular, for some years now. Our document most focused on scientists and engineers is called "Grade to Grad." There are some background papers that accompany it.

The title "Grade to Grad" means just that—that we think of the educational system as one system, K through continuing education of even professionals. Probably a fraction of what I do today not here, but at OTA—is education. So it is a continuing process.

We concluded that the education of scientists and engineers will require both traditional and what I would call nontraditional components of education—it is not just teachers in classrooms, but it includes museums and TV and Federal industrial laboratories and field and stream and teachers teaching and peers teaching and life's experiences, with some interpreters along the way. We see the process as very complex.

In terms of scientists and engineers, science and math education, we completely agree that a world class working force is an appropriate outcome of this broad scientific and engineering education, and superb scientists and engineers themselves. To answer a question you have asked others, it seems to us to require an effort different from the one we are now making. That translates into more money somewhere in the system, I suspect that is the answer, it will take more effort.

Chairman GLENN. Does OTA have an estimate of how much?

Dr. ANDELIN. No, sir. But in a sense yes. The way I characterize our work is that of an intellectual road map. If you know where you want to go, we will try to show you the ways to get there and the various costs. So to some extent, if you want to meet the goals that are set out for the year 2000, the annual costs in the next decade will be higher than if you are willing to accept reaching them in 2010. So whose goals, how serious, what kind of continuity do you want in this effort and so on? We can work, as we have, with your staff on——

Chairman GLENN. Does OTA know how much it would cost to meet it by the year 2000, how much it would cost by 2010, how much by 2020 and so on?

Dr. ANDELIN. Not those specific sets of goals. But, for example, you want to have the science and math teachers upgraded. There are hundreds of thousands of them, half a million as a round number. A summer course is $5,000 a piece, may be $10,000. And so you are very quickly at the $2, $4, $5 billion for a serious summer course. You can do it in one year, but you can't organize it that fast. You can do it in 5 years; you are talking a fraction of a billion a year for that.

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[1] See p. 72.

Billions are big numbers. I would comment, the billion dollars that the Feds are now spending on math/science education is $20 a student, and maybe a couple hundred dollars a teacher. To fix the teachers, in the sense of a summer course, you are talking thousands of dollars a teacher.

Chairman GLENN. And that is just the bait on what needs to be done, it is not a fix.

Dr. ANDELIN. Yes. We looked at what might be the numbers to put serious personal computers in schools, not the one token per classroom, but several per classroom, used appropriately for those school activities for which they are appropriate—not just for learning about computers—and those numbers were a few billion a year for a 5-year period. And I don't recall—we can certainly provide that—it may have been $3 or $4 billion a year, $10 or $15 billion total.

Chairman GLENN. You need teacher training programs and to go right along with that though. It is not just the cost of the computers.

Dr. ANDELIN. All one system. I think that is right, sir.

Chairman GLENN. I referred earlier to this estimate that somebody has made that to just upgrade our labs for teaching purposes in our schools would require somewhere around $10 billion. Have you seen that figure, and is that a reasonable figure?

Dr. ANDELIN. I have seen figures from a few billion for just some of the college-level stuff, to numbers—I think—I am not sure I have seen 10. I can refer to our staff that look at that more carefully. That is a perfectly reasonable number. I mean, where you draw that line is hard to say.

One of the things that the proper Federal coordination can do, which you are driving for and the purpose of today's hearing, is to figure out better ways of opening the Federal labs, or the federally funded industrial labs, for some opportunity of hands-on, or site visits to watch someone else hands-on if necessary, contact with these equipment and facilities. It is not realistic to put absolutely first class, all encompassing instrumentation and teaching equipment in all our schools. They are going to have to do some sharing. The $10 billion I'm sure has all kinds of cutoffs of so much per school district, not per school. And some school districts have schools down to five or six kids.

Chairman GLENN. Well, I favor the lab visits, the national lab visits and the industrial visits, and I think they are only effective where you can do them. But every school district in the country doesn't have access to those opportunities. I know experiences like this had a big impact on my own life. Way back when I was a kid I visited places like that and I was just utterly flabbergasted by all of the machines going, all of the science and so on. It had a big influence on me.

Dr. ANDELIN. If done right it makes science and engineering fun, not intimidating. If I might put a word or two about these reports, and then address more specifically the issues of Federal coordination—we concluded, in terms of the education of scientists and engineers, that there are basically three pieces of the Federal strategy. And it really isn't a Federal strategy, it is all the players again.

They are a recruitment strategy, a retention strategy, and then coordination.

Recruitment is simply to say that we know today immense numbers of young people who are fully capable of becoming scientists and engineers, and are fully capable of being good citizens in other fields with knowledge of science and math, who are not entering the field at all, or even taking the courses, independent of the field they go to. This strategy has to do with improvement of teachers and informal ed and museums and role models—and there are opportunities at all levels. It includes community colleges, it includes the historically black colleges and universities, the research colleges. Women and minorities are being left out for sure, and lots of others. Recruitment is a very long term strategy. It will not fix things of any sort by 2000. It will make more people thinking in science and math in terms throughout their careers, so if there is demand for them as such, they go that way, if there is not heavy demand for them in those occupations, they take that knowledge with them into business and government where we think it will be valuable as well.

Retention is a much shorter term strategy, and I suspect if you are looking at the year 2000, more of the retention strategies are what would be in order. Those tend more to be money options. That is, if you have somebody in undergraduate school who is leaning towards science or engineering but their debts are getting high or they have pressures to work for some other reason, they may need money; if you want Ph.Ds you need to put some funds into graduate traineeships, fellowships, whatever there might be. You also need to go after the teachers quite fast. It is clearly discouraging to be in a field you enjoy, but not have the teaching up to standards.

So the retention strategy is almost a way of identifying and buying; the recruitment strategy is creating a much larger group of people with interest and skills and capabilities.

Okay. Coordination is what you want to talk about today. Let me say just a few words about that. Clearly either the FCCSET Committee or your Interagency Council has the possibility of many of the elements of Federal coordination that are necessary. Whether either will actually accomplish it will unfortunately depend upon the good will of the folks doing it, and to some extent on some of the other structural elements. One that I had in my remarks to come later has to do with building in some kind of reward for cooperation. In many of the institutions that one can watch, whether it is government versus industry, or different government bureaucracies, there are not usually incentives to cooperate. Sometimes the way to build those is to build in disincentives for "discooperation," but that's the stick side. It is nicer to find the carrot side. And I don't have strong suggestions for that today, but I would bring it to the Committee's attention. Whether it is the FCCSET or whether it is your own Interagency Council, if you can find ways to make the agencies rewarded by cooperation, in their terms, whether it is a graceful hearing or a plaque or whatever——

Chairman GLENN. Well, expand on that a little bit. How would we reward them? I am all for it. I am not quite sure I know what you mean.

Dr. ANDELIN. Well, I wish I knew too, Senator.

Chairman GLENN. I can have four hearings a day with different people here if that will help bring some attention to it.

Dr. ANDELIN. I mean, you certainly have more experience than I at watching agencies go about their own business. As soon as you ask people to cooperate, you have to be aware of their time scale, and when your boss—and in some cases that may be the President who is boss of all—but if the boss expresses his or her will through different players, which is also the case——

Chairman GLENN. Well what you are saying is basically a coordinating group like this, whether S. 1951 or FCCSET, must dedicate itself to the national good and not just to protecting their own turf as a member of that Committee. And I am afraid that too often what happens is this turf protection by a member of some Committee.

Dr. ANDELIN. I am trying to state that positively. Yes, absolutely. I know the very narrow case of OTA, when we work with our Congressional colleagues, Congressional Research Service or GAO, we each have slightly different review processes, we have slightly different time scales, we have made different commitments to different members and committees on the Hill, and if something comes up that is urgent to us and we have promised to do something for somebody else and we don't have resources to do both, there is clearly a tendency to say, well, I will drop this coordination stuff for the moment because we don't get credit when that is done, they do, and we will finish our work. Now, we hope most of the time we are grown up enough to be responsible and meet our commitments, but that requires, as I said, the good will of the individual players.

If you or any other witnesses more skilled than I at institutional arrangements and reward systems can think about that, that would be useful. How do you, Department of Energy, Department of Education, NSF, benefit by being on this Committee and working with others? What did you get from them, what do you give to them?

One of the things I would charge that group to come back and say how can you, the Congress, help us reward ourselves for working together.

Historically coordinating committees in the Federal Government are usually used when there is some significant change underway, some new Federal regulations or changing international commerce such as biotech and high-performance computing. There hasn't been one in education, science and math education in particular.

It seems to me what you are saying, your Committee's work, even what Dr. Bromley said, is that fundamental changes are needed. If they are needed, then the fact that the changes aren't taking place isn't the excuse to not have coordination. You coordinate so you can make the changes happen if necessary.

We would hope that the differences in the agencies roles—they have very different roles—are seen by the Committee, and by themselves in this group, as strengths, not as problems to overcome. It is not meant to homogenize the Executive Branch agencies, but rather to build on their strengths. We know about the regional labs and centers. We know about their ties to universities and schools.

We have observed that mission R&D is often much more exciting to the general public and to budding scientists and engineers than some of the basic research that is also exciting to working scientists and engineers—clearly space and aeronautics and global and regional environmental concerns get people's imagination. And part of bringing people back into wanting science and math education is to have them interested in what you do with it. So we see the Federal executive agencies as very important in showing this excitement of science and math.

I would argue that coordinating the Federal agencies is important, even if it turns out, as you have suggested—and I suppose I have supported—that the present level of effort, even if beautifully coordinated, run very efficiently, isn't sufficient. To some extent, learning that would allow us to face the reality and decide either that we are going for third place or that we are going to put more resources in, and if we are going to put more resources in, where are we going to get them from.

As long as Federal efforts are not coordinated, the argument can keep being—perhaps correctly, until we know—"well, the resources aren't being well used, we need to rearrange pieces." Maybe we do, maybe we don't. After it is pretty well coordinated, you can ask them, "Is this your best effort?" If they come in and say "no, sir," you say, "well, then, how do we change it?" If they say, "yes, sir," you say, "well, it isn't big enough is it?" Or, "thank you, I'm glad it succeeded."

So that whether, again, it is S. 1951 or the executive action of the Administration itself, it is really important to find out how far they can go.

Chairman GLENN. We felt that before we start trying to expand programs, the first thing to do was make better use of what funds we have. And it appeared they are spread all over the lot, and they aren't coordinated. What this bill is trying to do is coordinate Federal programs.

Let me ask you a couple of specific questions. We have reporting requirements in S. 1951. That's one of the differences between our bill and the FCCSET Committee. We require the panel to report its findings and activities to the Congress every 2 years.

Ms. Kemnitzer, would you respond to that? Do you think that is a good idea, or do we not need that? We don't want to put in requirements that aren't going to do some good.

Ms. KEMNITZER. I happen to think reports are a good idea if they are well written and used to be a real tool to rally ideas and action plans. So, yes, I would say that your scheme of requiring reports is a good one. It helps keep focus on the fact that we need to have milestones and need to assess how far we have gotten toward those milestones on a regular basis.

Chairman GLENN. Dr. Andelin, do you agree with that, or do you think that is unnecessary? We don't want to just create more paperwork unless it is going to do some good.

Dr. ANDELIN. Well, our formal statement warns that that can indeed happen. To the extent that the group has appropriate oversight and can identify things—one of the responsibilities of a coordinating group has to be to identify the improvements needed in the system, both those within the authority of either that group or

the bodies they represent—the Executive Branch, if you will—and those that are at the moment outside of the authority presently given to them.

It is more critical to report the latter, those things that need to be done that they cannot do by executive order or individual action, back to the appropriate body—and that could be anywhere from the state school boards to the Congress. What they report is very important, as well as the mechanical reporting requirement. If they take it as seriously as they might, the reporting requirement is a wonderful one. If they decide to turn out boilerplate, we have seen lots of that.

Chairman GLENN. We also require NAS to evaluate the effectiveness of programs. Now, is NAS the right body to do that, and do you think that is a good requirement?

Ms. KEMNITZER. Well, I will say that I have some hesitation in answering yes, because my experience with the National Academy is that quality is very high, timeliness is sometimes a little slow. There is one group there, the Mathematics Science Education Board, that I have very high regard for that has been timely and action oriented. We might suggest that the Academy look at their operations as an example of the kind of response you would like.

Chairman GLENN. Dr. Andelin, would you favor that evaluation?

Dr. ANDELIN. Well, we think that guidance and oversight is very important. You provide some. We suggest in the testimony that PCAST be considered. It is possible that PCAST would then itself—I would say it is quite possible that they themselves might delegate it to the Academy, or to one of the science teacher groups.

If PCAST is charged with reporting, they can hire contractors or they can have someone else do it, or they could put a subcommittee together to do it themselves. What we find over and over again with issues of public policy today is that with one like this you want not just the academic community, but the business community, too. Not just the teachers but the scientists too. Similarly, not just business and scientists, but teachers and academics too. The Academy may not by itself represent all those bodies well.

Chairman GLENN. Length of duration. The FCCSET Committee is scheduled to go out of business the end of 1992, although, as an earlier witness pointed out awhile ago, the Committee may continue at the discretion of the science advisor.

Our Interagency Council would be permanent. Do you think it should be permanent, Ms. Kemnitzer?

Ms. KEMNITZER. I would suggest that you perhaps set an intermediate arrangement where it would expire in 10 years with a 5 year review, some sort of thing like that to, again, not set it up so that life is too soft and without limits, for even the council. And the year 2000, remember, is the goal target, so it makes sense to have something that it is around that time period.

Chairman GLENN. Do you think we can meet that goal?

Ms. KEMNITZER. Sure.

Chairman GLENN. What kind of resources is it going to take to do it?

Ms. KEMNITZER. More than we are spending now.

Chairman GLENN. Like how much?

Ms. KEMNITZER. Well, our group did not go through it, so I could only give you off the cuff.

Chairman GLENN. Okay. I share your concerns on this. I don't think we are putting nearly enough into this, and especially if our goal is by the year 2000. As we pointed out earlier, a lot of those kids are in second or third grade right now, and to think that we are going to change the world for them in math and science and have them graduate from high school with a whole new approach to this thing I think is wishful thinking. That is unless we are willing to really pour in some resources and do an awful lot. It isn't going to happen on a few hundred million here, or a billion over a 10 year period or something.

Ms. KEMNITZER. As well as working in these macro policy areas, I am President of the school board of my sons' schools—they are 9 and 7—I could tell you that the amount of effort is enormous to change just one school in this regard, so I don't want to be flip about how easy the task will be.

Chairman GLENN. If we get into reorganization, you as a school board member, do you think we are going to have to give up some local autonomy? Are we going to have more autonomy at the local level? That is what basically the last 10 years has done, is said okay, we are getting out of this business, we are throwing it back to the States. It is de-reg in another way, if you want to put it that way.

Ms. KEMNITZER. Well, throwing it back to the States does not necessarily mean local autonomy. It may mean more State bureaucracy.

Chairman GLENN. It might at the State level. That is up to the States, but I'm talking about as far as what happened at the Federal level, as Senator Hatfield pointed out. We wanted to do away with the Department of Education at one time. That just showed the lack of commitment in education. We peeled back some almost a third, I guess, in Federal commitment to elementary and secondary education, or at least we went from about 9 something percent to 6.1 or 6.2 percent now, whatever it is, a big reduction.

Are we going to have to reorganize at the Federal level in order to get the goal by the year 2000?

Ms. KEMNITZER. My experience is that the schools change when the parents and the local business leaders work together with the teachers. And I see the Federal role in elementary and secondary should be focused on the teachers in terms of teacher training, getting them the resources that they need, with those alliances of the business and parent groups. Probably the most interesting meeting I went to recently was of community-based groups, NAACP, Urban League, Girl Scouts, 4-H, et cetera, et cetera, with various science professional societies. And the degree to which those kind of cooperation and exchanges are going on is multiplying, and I think is very helpful.

Chairman GLENN. Dr. Andelin, what length of duration do you think FCCSET or S. 1951 should have? The FCCSET committee goes out of business at the end of 1992. We make ours permanent. Do you favor a permanent group?

Dr. ANDELIN. One of my observations about permanent roles is that "All final decisions are temporary but some last longer than

others." Two years feels like lame duck. That group has to be taken seriously if it is to be effective, and the Administration deadline feels short if others are to take it seriously. It takes so long to get things going, to get the members to designate their representatives and to meet and to feedback and to get the data——

Chairman GLENN. What would you favor? Would you favor making it a permanent organization, or have some limitation on it, as Ms. Kemnitzer says?

Dr. ANDELIN. Ten years and forever is beyond my——

Chairman GLENN. I guess my view on permanency is that I don't see us solving this problem in 10 years. We can set that as a goal, and I think as long as we haven't really gotten to where we want to go we are going to need this kind of a group. That's the reason we made it permanent.

Dr. ANDELIN. You could always have it until such time as the President certifies there is no longer a problem. I mean, no organizational arrangement or timing takes the place of wisdom and vigilance and commitment, and that's what we are trying to talk about.

I think that refers also to your question about is it going to be the Feds expanding or is it going to be more at the state and local level. I would be surprised if it isn't all the above. If the community is not itself involved in the educational process, it will feel that something has been imposed from the top, and I expect that is not the only answer, and maybe not an answer at all.

You asked about research. The answer is yes, we need research all over the place to know what does or doesn't work, to even know how to evaluate whether or not it has or hasn't worked.

When you asked about the reorganization, most of the people that seem to have a really good gleam in their eye about where we are going are talking about reorganization of the communities, not just the schools. We talked about the changing demographics, the changing international conditions. Our family structures are not the same as they were when you and I went to school, and the schools can't quite replace that, and maybe the community more broadly can begin to supplement some of what the individual family structure has lost.

Chairman GLENN. I agree. We are undergoing some enormous societal changes in the United States involving single parent families and working mothers and things like that. This is very different from most other places around the world. These changes contribute in varying degrees to the problem we are talking about. And we are not addressing any of those things. We are addressing specifically education, but I certainly think that any restructuring has to consider those things, just like we are voting on daycare centers all over the country over here now, and Head Start programs, and things like that that feed into this whole problem.

We are going to have to end. Dr. Weiss put a little note up here a little while ago and said, "We have a habit of setting ambitious goals in education and underfunding them."

That is the understatement of the week. But after Sputnik we got all fired up about it and did a pretty good job for a short period of time, because the Russians were coming, watch out, the Russians are coming. We had no idea that the Russians would ever be able

to do something as technically advanced as put a satellite up when we had failed to do it. That sort of jarred us a little bit. We spent at the Federal level about $1 billion over the next 25 years, which translates into $40 million per year, or $2,500 per year per school district.

It is not a big surprise that we have fallen behind the rest of the world, as their national disposable income has increased and they have recovered from World War II. These nations are putting resources into education and into research.

In almost every speech I give I talk about what built this country. It is not all resources, it is not all fruited plain and purple mountain majesties and rivers flowing to the sea. It is—number one, education. In this country, it was not just for the kids from the castle, or the rich kids, or the politically connected—it was for everybody. And we didn't do a perfect job. But we did a job better than anyone else in this world, up to now. Now we are beginning to drop back and other nations are exceeding the United States of America in education. And that is a bad sign.

And the other area, of course, is basic research. We have poured more money into basic research than any other country. And now other nations are beginning to out-do us in certain selected fields and so we have to get going. And that is what this concern about math and science and technology and education is all about.

So I guess that is a good summary for our hearing this morning and what we are trying to do on this, and we will undoubtedly have some more questions for you. We hope you will respond in writing. It will be included in the record.

Thank you for being here this morning. The Committee will stand in recess subject to the call of the Chair.

[Whereupon, at 11:53 a.m., the Committee adjourned subject to the call of the Chair.]

101ST CONGRESS
1ST SESSION

S. 1951

To promote interagency cooperation in the area of science, mathematics and technology education.

IN THE SENATE OF THE UNITED STATES

NOVEMBER 21 (legislative day, NOVEMBER 6), 1989

Mr. HATFIELD (for himself, Mr. GLENN, Mr. ADAMS, Mr. PACKWOOD, Mr. JEFFORDS, Mr. BINGAMAN, Mr. FOWLER, Mr. LIEBERMAN, Mr. KOHL, and Mr. NUNN) introduced the following bill; which was read twice and referred to the Committee on Governmental Affairs

A BILL

To promote interagency cooperation in the area of science, mathematics and technology education.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

SECTION 1. FINDINGS.

The Congress finds that—

(1) several Federal agencies have strong education programs with applications to mathematics and science education; and

(2) better coordination of the efforts being undertaken by the National Science Foundation, the Depart-

ment of Education and other Federal agencies could have a significant impact on educational reform in the areas of mathematics and science.

SEC. 2. DEFINITIONS.

For purposes of this Act the term—

(1) "Federal agency" means any department, agency, or other instrumentality of the Federal Government, including any Government corporation; and

(2) "member agency" means any Federal agency which is represented on the Interagency Council on Science, Mathematics, and Technology Education.

SEC. 3. INTERAGENCY COUNCIL ON SCIENCE, MATHEMATICS, AND TECHNOLOGY EDUCATION.

(a) ESTABLISHMENT OF INTERAGENCY COUNCIL.—Within ninety days after the date of the enactment of this Act, the President shall establish the Interagency Council on Science, Mathematics, and Technology Education (hereafter referred to as the "Interagency Council"). The membership of the Interagency Council shall include the—

(1) Director of the Office of Science and Technology Policy;

(2) Secretary of Education;

(3) Director of the National Science Foundation;

(4) Secretary of Energy;

(5) Secretary of Defense;

(6) Secretary of Agriculture;

(7) Secretary of Labor;

(8) Secretary of Health and Human Services;

(9) Secretary of Transportation;

(10) Administrator of the National Aeronautics and Space Administration;

(11) Administrator of the Environmental Protection Agency; and

(12) any other Federal officials involved in science, mathematics, and technology education which the President may consider appropriate.

(b) CHAIRMAN.—The Director of the Office of Science and Technology Policy shall serve as Chairman of the Interagency Council.

(c) DUTIES.—The Interagency Council shall—

(1) review and identify the science, mathematics, and technology education programs and activities of each member agency to ensure coordination among such agencies;

(2) identify and make recommendations for eliminating conflicts, inconsistencies, and unnecessary duplications between or among such programs of member agencies;

(3) facilitate interagency communication on such programs and activities carried on by Federal agencies; and

(4) contract with the National Academy of Sciencies for an evaluation of the effectiveness of member agencies in disseminating such programs and activities to the public and among the member agencies.

(d) BIENNIAL REPORT.—The Interagency Council shall prepare a report that—

(1) reviews and identifies the science, mathematics, and technology education programs and activities of each member agency to ensure coordination among such agencies;

(2) identifies and makes recommendations for eliminating conflicts, inconsistencies, and unnecessary duplications in such programs and activities;

(3) identifies the major policy goals of such programs and activities carried on by member agencies;

(4) shall be submitted to the President, the Congress, and the head of each member agency no later than two years after the date of enactment of this Act and every two years thereafter, and shall be made available to the public.

(e) MEETINGS.—The Interagency Council shall hold no fewer than three meetings in each calendar year. Within

ninety days after the date of the enactment of this Act, the Chairman shall call the first meeting of the Interagency Council.

(f) ADVISORY COUNCIL.—The Interagency Council is authorized to establish, if necessary, an advisory committee on science, mathematics, and technology education.

SEC. 4. AUTHORIZATION OF APPROPRIATIONS.

There are authorized to be appropriated $300,000 for fiscal year 1990 and such sums as may be necessary for each of the succeeding four fiscal years to carry out the provisions of this Act.

SENATOR MARK O. HATFIELD
TESTIMONY ON S.1951, FEDERAL INTERAGENCY
COOPERATION IN MATHEMATICS AND SCIENCE EDUCATION
SENATE GOVERNMENTAL AFFAIRS COMMITTEE
JUNE 14, 1990

Good morning Mr. Chairman and Members of the Committee. It is a pleasure to be here today to discuss one of my favorite issues - federal interagency cooperation. I believe the federal government is the most effective when it operates as a team (of course I have a fine example of teamwork in Oregon right now - the Portland Trail Blazers). To do so, requires leadership, vision and the dedication of every single player. Today's hearing serves to demonstrate the commitment of our government -- from Congress to the Executive -- to improving the emerging crisis in mathematics and science education, through a complete mobilization of federal resources.

Mr. Chairman, you and I have traversed a long path since last November when we first introduced this legislation,

calling for increased federal cooperation in mathematics and science education. We have both attended numerous hearings on this subject and have devoted many hours to building a blueprint for enhanced federal participation.

We clearly stand committed to this extremely pressing issue. And now we have the attention of our colleagues. In the last two years, the mathematics and science education crisis has risen from virtual obscurity to political center stage. For example, the resolution we introduced two years ago calling on Congress to make mathematics and science education a top priority received only a handful of cosponsors, and generated little interest.

Today, however, it is nearly impossible to pick up a newspaper or magazine, or turn on the television, without hearing the latest statistics about the crisis. This

heightened visibility has paved the way for the most comprehensive mathematics and science education legislation in this decade; S.2114, which is due to be marked-up by the Senate Labor Committee next week.

I recently learned of a situation Mr. Chairman, which further amplifies the needs of our nation in the mathematics and science fields: a simple math mistake -- somebody added when he or she should have subtracted, or vice versa -- caused the Hubble Space Telescope to miss its target stars and point to the wrong spot in the heavens. The telescope missed its target by one half of a degree -- or about the width of a full moon as seen from Earth, causing a one-week delay in publication of the first star pictures.

Now, this is not a monumental error. However, it serves to illustrate the point that even the most basic

mathematics and science skills are critical to almost everything imaginable -- from watching the heavens to turning on our headlights. And quite frankly, our children are not measuring up in these crucial areas.

The facts are clear: this country finds itself in the midst of a very dangerous crisis in mathematics and science education. Virtually everyone has heard about the standardized mathematics and science tests given to young people in more than a dozen industrialized countries: American students ranked at or near the bottom of every single one. No matter how we as policymakers interpret these results, they do not befit our superpower status.

The reasons behind these statistics are obvious. Over 7,000 high schools in the United States do not even offer a course in physics, 4,000 do not offer chemistry,

and 2,000 do not offer biology. Seventy-five percent of all junior high school science teachers in the United States today do not meet the minimum certification requirements of the National Science Teacher's Association. And most distressingly, one-third of our high schools do not offer enough mathematics courses to prepare even the best students to enter engineering school.

Additionally, we can no longer rely on the traditional pool of 22-year old white males to enter the science -- the numbers are declining drastically. Clearly, we must develop an inclusive strategy to expand our pool of potential scientists and engineers to include vastly increased numbers of students, particularly women and minorities. And I believe that the federal government must lead the way.

While some people may think of mathematics and science as isolated and removed subjects, they literally have an effect on everything: from our productivity at home to our competitiveness abroad -- as well as on the quality of life we enjoy in this country. Yet, in the absence of dramatic and immediate change, the Office of Technology Assessment predicts a shortfall of 700,000 trained scientists and engineers within the next decade.

Of course I give a great deal of the credit for this enormously heightened visibility to President George Bush: by making improvement in mathematics and science education a centerpiece of his State of the Union address, he has made the issue a national priority. He has also instructed his Science Advisor, Dr. Bromley, to convene a Federal Coordinating Council on Science, Engineering and Technology (FCCSET) which will focus on education and human resources. The FCCSET Committee is

now conducting an inventory of federal initiatives in mathematics and science, and is planning a coordinated budget submission for fiscal year 1992. I couldn't be more pleased with the leadership provided from the Administration.

Yet, we must not underestimate the critical importance of the visibility this issue now has: in Washington -- where 1,001 important issues are competing for attention -- this issue is now at the top of the agenda. Our challenge is to seize this opportunity and implement dramatic initiatives now. Mobilization of our federal resources is imperative if we are to substantially impact on this crisis.

I believe S. 1951 represents the necessity of deploying all of our resources to attack this crisis. Three of its provisions are vitally important: (1) the bill requires

the FCCSET Committee to report to Congress on a biannual basis, (2) it provides for outside review and consultation by the National Academy of Sciences, and (3) it makes a committee on human resources and education a permanent structure at the federal level. Each of these provisions will strengthen our hand.

We will face hurdles to cooperation, and to a certain degree, we already have. Therefore, as the Ranking Republican on the Senate Appropriations Committee, I am pleased to announce that every fiscal year 1991 Senate Appropriations bill will include language about the emerging mathematics and science education crisis and will encourage all of the federal mission agencies to evaluate and enhance their ongoing activities in these areas. Teamwork is essential in this crisis -- our children, our future depend on it.

Thank you for the opportunity to testify on S.1951.

>> END <<

STATEMENT
BY
J. THOMAS RATCHFORD
ASSOCIATE DIRECTOR FOR POLICY AND INTERNATIONAL AFFAIRS
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
EXECUTIVE OFFICE OF THE PRESIDENT

BEFORE THE
UNITED STATES SENATE
COMMITTEE ON GOVERNMENTAL AFFAIRS

JUNE 14, 1990

Mr. Glenn, Members of the Committee:

I am pleased to be here today to discuss the issue of interagency coordination in science and mathematics education. This committee is to be commended for its interest in addressing the science and mathematics education challenge facing this country. Clearly, all of us have to work together to meet this challenge and solve the problems we face.

I am accompanied today by Dr. Luther Williams, Assistant Director for Education and Human Resources at the National Science Foundation, Mr. Christopher Cross, Assistant Secretary for Educational Research and Improvement at the Department of Education, and Mr. Richard Stephens, Director of University and Science Education at the Department of Energy.

The problems this nation faces in science and mathematics education are well documented. The state of science and mathematics learning among our children, youth, and college-age adults is very disturbing. Dr. Allan Bromley, Assistant to the President for Science and Technology and Director of the Office of Science and Technology Policy, has stated on numerous occasions that unless we make fundamental changes in our educational system, the United States faces the prospect of a decline in its international standing.

The President and this Administration are fully aware of the problems we face in this area and have made significant strides in addressing this issue. As you know, the Education Summit held by the President and the nation's Governors led to a set

of National Education Goals and objectives to be reached by the year 2000. Science and mathematics learning are central to those goals, which include the following:

> By the year 2000, American students will leave grades four, eight, and twelve having demonstrated competency in challenging subject matter including English, mathematics, science, history and geography [emphasis added]; and every school in America will ensure that all students learn to use their minds well, so they may be prepared for responsible citizenship, further learning, and productive employment in our modern economy; and
>
> By the year 2000, U.S. students will be first in the world in science and mathematics achievement.

These goals form a national framework for Federal policy and strategic investments in science, mathematics, technological, and engineering education at all levels. However, to achieve these goals, it will be necessary for all concerned parties to work together. Our teachers, students, industry, academia, State and local governments, and the Federal government -- Congress and the Executive Branch -- all have important and varied roles to play.

Federal Initiatives in Science and Mathematics Education

Through the FY 1991 budget, the President has placed high priority on programs and funding for science and mathematics education. The FY 1991 budget proposes over $1 billion in direct spending in five agencies for science, mathematics, and engineering education, an increase of 26 percent above FY 1990. These programs are designed to advance general scientific literacy and mathematics numeracy and to prepare the next generation of scientists, engineers, and technicians.

The Department of Education (ED) and the National Science Foundation (NSF) have substantial programmatic responsibility for science, mathematics, and engineering education, with critical supplementary roles played by the Department of Energy (DOE), the National Aeronautics and Space Administration (NASA), and the National Institutes of Health (NIH). Other agencies play important supporting roles as well.

The Department of Education is responsible for programs of teacher training, research and improvement, dissemination and technical assistance, and targeted efforts for the disadvantaged and special student populations. The Department's programs reach every State and nearly every school district throughout the nation. The Department provides support for science and mathematics education through national, merit-based competitive research and improvement grants, formula grants to State and local education agencies, and competitive grants to postsecondary institutions to improve undergraduate programs. In addition, the Department's

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graduate fellowships in areas of national need are all devoted to the natural sciences and engineering.

A substantial portion of the President's education initiatives are focused on Department of Education efforts to improve the general condition of science and mathematics education and to increase the pool of talent in the fields of science, mathematics, and technology. The proposed National Science Scholars program would provide support for undergraduates who are pursuing science, mathematics, and engineering degrees. Many schools supported under the proposed Magnet Schools of Excellence program are expected to adopt science, mathematics, or technological themes. And the proposed Alternative Certification program is designed to help States attract experienced professionals -- many from the fields of science, mathematics, and engineering -- into teaching.

The Department of Education's FY 1991 budget calls for substantial increases in funding for programs directly focused on science and mathematics education. The 1991 budget proposes $230 million, an increase of $94 million or 70 percent over FY 1990, for the Dwight D. Eisenhower Act Mathematics and Science education program. These funds primarily support formula grants to States and local school districts for professional development, leadership training, and school-college partnerships to leverage innovation at the elementary and secondary school levels. In addition, the budget calls for a $500 million increase in Chapter 1 funding for education of the disadvantaged, a portion of which will be used by local school districts for remedial mathematics education.

The Department of Education also supports R&D, dissemination of information on exemplary practices, and technical assistance on science and mathematics education. The Department's Office of Educational Research and Improvement (OERI) supports research and indicator studies on science and mathematics in ten of its research centers -- three of which are entirely devoted to science, mathematics, and technology -- and through longitudinal studies and the National Assessment of Educational Progress funded by the National Center for Education Statistics. Information on exemplary practices is disseminated to the field through the National Diffusion Network, information clearinghouses, and regional laboratories funded by OERI; and Eisenhower Act State directors network and technical assistance centers funded by the Office of Elementary and Secondary Education.

The National Science Foundation's activities are based on the view that the educational process must stimulate the interest of all students so as to ensure that the Nation will have both the scientists and engineers it needs for the future and the technically literate workforce we need as we enter the 21st century. In FY 1991, NSF proposes to invest $463 million in programs that support science and engineering education and human resources. This represents an increase of 30 percent over last year and includes activities ranging from the precollege level to the undergraduate and graduate level along with a specific focus on programs designed to attract women, minorities, and the disabled to science and engineering at each level of the educational continuum.

NSF has supported a number of programs over the last few years to support its educational objectives. For example, NSF administers a program that provides Presidential recognition of our very best mathematics and science teachers to enhance the status of the profession. And NSF has refocused its training and retraining efforts to reach greater numbers of teachers. NSF has established teacher support networks to improve teacher interaction with practicing scientists and engineers. The agency has stressed the creation of private sector partnerships between scientists and engineers, colleges and universities, and other research institutions with local teachers and schools. The Foundation supports the use of innovative advanced technologies and materials within elementary and secondary schools. In addition, NSF has been successful in efforts to involve the publishing industry by getting them to contribute resources and work with schools, school districts, and academic curriculum development teams all across the nation. NSF also has put in place programs that focus on stimulating and reinforcing the interest of high school students in science and mathematics.

In the FY 1991 budget, NSF has proposed two new important programs. The first is the NSF Statewide Systemic Initiative in science, mathematics, and engineering education. With this effort, NSF will take the next step by working with the States to plan, design, and take action that only the States can initiate to bring about major educational change. These efforts are expected to be comprehensive. They will make use of the education improvement efforts that are beginning to come from many of the NSF-supported teacher training and curriculum development projects. The applicants for this initiative are being encouraged to describe how they will use Department of Education categorical programs, such as the Eisenhower Act, Chapters 1 and 2 of the Elementary and Secondary Education Act, and vocational education funds to enhance their proposed efforts. Most importantly, the States Initiative is designed to produce the systemic, comprehensive changes necessary for major improvement of the teaching and learning of science and mathematics at all educational levels (i.e., K-12 and college) by involving teachers, the business community, State and local education entities, etc.

This strategy to effect fundamental change in education and human resources is also reflected in the FY 1991 NSF proposal to start the Alliances for Minority Participation program. For the past two decades there have been many efforts to improve the participation of minorities in our science and technology enterprise. But minorities still remain severely under-represented in science and engineering. Attacking this problem successfully will not be accomplished solely by NSF, higher education, industry, or the private sector alone. It has to be a collaborative effort among all of these participants. This has led to NSF's Alliances program to support efforts that concentrate on increasing the number of undergraduate and graduate degrees going to minority students in science and engineering.

NSF also has a significant effort to support improvements in undergraduate and graduate science and engineering education. Many of these activities are closely

linked to the research programs. This provides a close and necessary coupling of education and research.

The Department of Energy's 1991 budget proposes $25 million for science, mathematics, and engineering education through its Office of Energy Research. DOE programs include science and mathematics research exposure for middle and high school students, research training of undergraduates, and graduate fellowships in science and engineering. The DOE supports over 6,000 undergraduates, graduate students, and college and university faculty through research fellowships.

At the National Aeronautics and Space Administration, $50 million, or an increase of 35% over FY 1990, is requested to support educational outreach programs for grade school through graduate school. Included are educational programs targeted at elementary and secondary students, elementary and secondary teachers, students and faculty at colleges and universities, the adult general public (particularly parents of pre-college students) and underrepresented minorities in science and engineering education.

The National Institutes of Health provide $292 million in training grants for almost 12,000 graduate trainees in research laboratories. That is over and above the thousands of graduate and post-graduate research opportunities offered students through NIH research grants.

Coordination of Federal Science and Mathematics Initiatives

OSTP is committed to developing and maintaining a well-coordinated interagency Federal program in support of science and mathematics education. The department and agency programs described above represent, collectively, some of the Administration's initial efforts to assist States and local communities in achievement of the National Goals developed by the President and the Governors. The effects of these programs will be limited, however, unless they are closely coordinated across agency lines and unless they work in concert with reforms in the States, local school districts, and schools, colleges, and universities.

Dr. Bromley has committed OSTP to maintain a well-coordinated Federal policy and programmatic presence in support of school and college opportunities and reforms. We plan to achieve this coordination through the new Committee on Education and Human Resources within the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET).

The newly revitalized and reorganized FCCSET is charged with reviewing and coordinating science, engineering, and technology activities that affect more than one Federal agency. FCCSET, which is comprised primarily of Cabinet secretaries and heads of independent agencies, has established seven umbrella committees in the areas of earth and environmental sciences; education and human resources; food,

agriculture, and forest research; international science, engineering, and technology; life sciences and health; physical, mathematical, and engineering sciences; and technology and industry. Our intention is to cover a broad range of issues in science and technology. In turn, FCCSET will provide input into the President's Cabinet Councils, such as the Domestic Policy Council and the Economic Policy Council, on major policy issues that contain substantial elements of science and technology.

The new FCCSET Committee on Education and Human Resources is chaired by Secretary of Energy James Watkins, with the Under Secretary of Education, Ted Sanders, and the Assistant Director for Education and Human Resources of NSF, Luther Williams, serving as vice chairs. The Committee will coordinate, on a continuing basis, activities of the Federal agencies related to science, mathematics, engineering, and technological education, training, and human resource development, in coordination with existing President's Cabinet Council working groups, such as the DPC Working Group on Education chaired by Secretary Cavazos. The Committee's work will promote more efficient use of the expertise that exists in the agencies, avoid needless duplication, identify areas of new program opportunities, and make more efficient use of limited Federal resources. The objective of this new FCCSET Committee is to develop a truly integrated interagency effort in:

- o strengthening science, mathematics, engineering, and technology education at all levels; and

- o developing and maintaining a technologically and scientifically literate workforce to keep the nation competitive in global markets.

The members of the FCCSET Committee on Education and Human Resources will include senior policy-level officials from all Federal agencies with significant responsibilities in the area of science, mathematics, engineering, and technological education, including those with jurisdiction over the education of scientists, mathematicians, and engineers, as well as those with responsibilities for technician training and science literacy for the general public. The Committee will also include those agencies that are major users of scientific and engineering personnel.

The agencies that are potential members of the FCCSET Committee on Education and Human Resources include: the Departments of Agriculture, Commerce, Defense, Education, Energy, Health and Human Services, Interior, Justice, Labor, and Transportation, Veterans Affairs, the Environmental Protection Agency, NASA, NSF, and the Smithsonian Institution. The Office of Management and Budget, the Office of Science and Technology Policy, and the Office of Policy Development serve as Ex-Officio members. The Committee Charter and membership will be completed and approved in a few weeks.

However, given the urgency attending science and mathematics education, for several months I have chaired an interagency group composed of the principal agencies involved in science and mathematics education to address issues requiring immediate attention. Substantial progress has been made in understanding agency

programs, identifying areas of complementary program priorities, and encouraging joint funding initiatives.

As a subset of this more broadly based interagency effort, OSTP has worked closely with ED and NSF to improve coordination of science, mathematics, and engineering education programs between those two agencies. OSTP's March 1, 1990, report to the Senate Appropriations Committee on ED-NSF coordination is provided as an attachment.

In that report we noted that the Secretary of Education, Lauro Cavazos, and the Director of the NSF, Erich Bloch, have established formal mechanisms for coordination of science and mathematics education programs between the two agencies. The Director of NSF appointed Luther Williams to chair the coordination effort for NSF. Christopher Cross has been charged with heading the coordination effort for ED. Coordination at all appropriate levels between ED and NSF is the continuing responsibility of these high-level officials.

Initial results of these coordination efforts have been excellent. For example, ED has initiated dissemination efforts with the NSF and others, whereby ED clearinghouses, regional laboratories, and the National Diffusion Network will provide States and localities with timely knowledge about exemplary materials and practices. In addition, ED and NSF are discussing a special Upward Bound initiative to provide minority high school students with opportunities similar to those provided by the NSF Regional Career Access Centers. Another noteworthy example of the enhanced coordination between ED and NSF is the commitment of the Department to promote the availability of its Eisenhower Act mathematics and science funds for use in conjunction with the recently announced NSF-sponsored Statewide Systemic Initiative.

The bill the Committee is considering, S. 1951, would establish an interagency committee on science and mathematics education. Such a structure would duplicate the purpose and mission of the FCCSET Committee on Education and Human Resources. It is clear that OSTP, through its enabling legislation, has sufficient authority to establish such an interagency committee. In my judgment, we have exercised that authority in a constructive manner with the establishment of the FCCSET Committee on Education and Human Resources. Considerable progress respecting interagency coordination has been realized in a few short months, and we expect more progress in the weeks and months ahead. Therefore, I believe this legislation to be unnecessary in light of actions already taken.

My colleagues here today representing the Departments of Education and Energy and the National Science Foundation share this view, which, in itself, serves as an example of the coordination and close cooperation already underway.

I appreciate the opportunity to appear before the Committee today and I would be happy to answer any questions you might have.

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REPORT OF THE
OFFICE OF SCIENCE AND TECHNOLOGY POLICY
TO THE
UNITED STATES SENATE APPROPRIATIONS COMMITTEE
MARCH 1, 1990

COORDINATION OF U.S. DEPARTMENT OF EDUCATION AND NATIONAL SCIENCE FOUNDATION PROGRAMS IN MATHEMATICS AND SCIENCE EDUCATION

SUMMARY

This report responds to language in the Senate Appropriations Committee report on the FY 1990 appropriation for the Office of Science and Technology Policy (OSTP) (Senate Report 101-128). The Committee expressed concern about the level of coordination between the Department of Education (DoEd) and the National Science Foundation (NSF) to improve mathematics, science, and engineering education and requested that the OSTP "take immediate steps to improve any and all coordination problems between the two agencies..." This report describes the progress that has been made in improving coordination between the Department of Education and the National Science Foundation on programs relating to mathematics, science, and engineering education. The report also describes actions of the Director of OSTP to coordinate efforts of all Federal agencies which have substantial interests in mathematics, science, and engineering education.

To achieve the national goal for mathematics and science education, a strategy for (1) improving coordination in mathematics, science, and engineering education between DoEd and NSF in the immediate future, and (2) developing a coherent Federal effort in mathematics, science, and engineering education in the longer term, is being developed.

- A high level, visible formal coordinating mechanism has been agreed on and is being implemented between the DoEd and the NSF to deal with immediate issues and problems.
- OSTP is establishing a Federal coordinating committee to coordinate activities of all Federal agencies in mathematics and science education.

Introduction

Federal, national, State, and local efforts to reform mathematics and science education are coalescing to support the national goal for American students to be first among industrialized nations in mathematics and science achievement. This goal was articulated by the President in the State of the Union Message and by the Governors in their meetings this week in Washington. The Office of Science and Technology Policy (OSTP) is working directly with the leadership of the Department of Education (DoEd) and the National Science Foundation (NSF) to strengthen the efforts of both agencies to meet this goal. The DoEd and NSF have key leadership roles and significant budgets to lead the Federal effort in supporting the States and the localities as they exercise their responsibilities for education reform and improvement.

The OSTP, DoEd, and NSF agree that improved coordination between DoEd and NSF is desirable. Indeed, improved cooperation and coordination is essential to improving mathematics and science education. The latter two agencies have agreed to a strategic planning effort with a clear focus on student learning. Action resulting from that joint planning will assist States, local school districts, schools, and postsecondary education institutions to address major issues and to reform essential education system components related to achievement in mathematics, science, and engineering.

Coordinating the work of DoEd and NSF is an important first step in increasing the overall effectiveness and productivity of the Federal effort in improving mathematics, science, and engineering education in the nation. The magnitude of educational reform in the scientific and technical fields and the length of time needed for successful reform necessitate excellent coordination and collaboration among **ALL** Federal agencies with interests in science and technology. To that end, the Director of OSTP, as Chairman of the newly revitalized Federal Coordinating Council on Science, Engineering, and Technology (FCCSET), is taking action to create a FCCSET Committee to deal with human resources and education. The Committee will address significant national policy issues which cut across agency boundaries and will provide a formal mechanism for interagency policy coordination and exchanges of information regarding education and human resource development for science and technology. The Committee will be organized in time to coordinate the development of 1992 budget submissions by the agencies.

The Short Term: Formal Coordination Between the Department of Education and the National Science Foundation

The Secretary of Education (Lauro F. Cavazos) and the Director of the NSF (Erich Bloch) have established formal mechanisms for coordination of mathematics and science education programs between the two agencies. The Director of NSF appointed his Senior Science Advisor (Luther S. Williams) to chair the coordination effort for NSF. The Assistant Secretary for Educational Research and Improvement (Christopher T. Cross) has been charged with heading the coordination effort for DoEd. Coordination at all appropriate levels between DoEd and NSF is the continuing responsibility of these high-level officials. These new coordination efforts replace present ad hoc coordination arrangements.

The formalization of coordination between DoEd and NSF will enable the agencies to plan strategically for an effective Federal effort in the achievement of the national goal in mathematics and science education. It will be possible for the agencies to develop joint programs which focus limited Federal funds on critical factors for improving mathematics, science, and engineering education. A more immediate action the agencies will undertake is strengthening the ties between existing programs which complement and support each other in the achievement of the national goal. Specifically, the DoEd and NSF have agreed that the following programs and activities will be coordinated initially under this new arrangement:

- distribution of NSF educational materials by the DoEd dissemination networks;
- research and development of educational technologies, teaching and learning strategies, and policy for mathematics and science education;
- programs to enhance national and international assessments of student learning in mathematics and science, studies of international comparisons of precollege mathematics and science education, and international mathematics and science educational achievement indices;
- cooperative support of State systems and urban districts to improve mathematics, science, and engineering education;
- programs for increasing participation and achievement of traditionally underrepresented groups in mathematics, science, and engineering education; and
- undergraduate level mathematics, science, and engineering education, including preparation of teachers and faculty.

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Use of DoEd Dissemination Networks to Publicize NSF Projects

It is important that high quality materials and documentation of exemplary practices developed by either NSF, DoEd, or jointly by the two agencies reach State and local education agencies. DoEd has dissemination and distribution networks among schools and States, including the National Diffusion Network, the Regional Education Laboratories, the network of coordinators for the Eisenhower Act Mathematics and Science Education Programs, and the Urban Superintendents' Network. The precise mechanisms to be used to increase the flow of high quality projects funded by NSF into the DoEd's existing dissemination networks will be developed jointly by DoEd and NSF.

Research and Development of Educational Technologies, Teaching and Learning Strategies, and Policy for Mathematics and Science Education

The NSF, through its educational technology program, and the DoEd, via its National Educational Research and Development Centers and the Fund for the Improvement and Reform of Schools and Teaching (FIRST), are supporting significant efforts designed to provide technologies for hands-on science education experiences and improvement of higher order thinking skills, and novel approaches to mathematics and science learning and instruction. A coordinated research and development strategy will greatly leverage Federal expenditures.

Enhanced National and International Assessments of Student Learning in Mathematics and Science, Studies of International Comparisons of Precollege Mathematics and Science Education, and International Mathematics and Science Educational Achievement Indices

One of the most important post-summit/national education goal activities will be the development of appropriate national and international comparative assessments of student learning in mathematics, science, and related technical education. DoEd and NSF already have a strong track record of collaboration and joint funding in national and international assessments of student achievement. Both the DoEd and the NSF are currently funding mathematics and science education achievement indices and international comparisons of mathematics and science performance.
Under the new coordination arrangements, the DoEd and the NSF will establish mechanisms for increased collaboration in national assessments of student achievement in mathematics and science, possibly including co-funding of specific projects as appropriate. A major activity will be to coordinate the needed research, experimentation, and trials of appropriate performance, portfolio, and related assessments which measure authentic acquisition of knowledge, habits of mind, and skills related to mathematics and science.

Cooperative Support of State Systems and Urban Districts

The DoEd and the NSF will pursue cooperative support of State systems and urban districts to improve mathematics, science, and engineering education. Drawing on the resources of the Precollege Division of the Science and Engineering Education Directorate of NSF, and the Eisenhower Program of the

DoEd, explicit strategies will be developed for identification of high priority target uses for the funds made available to States and urban districts through the Eisenhower program and those funds granted to States by NSF to promote systemic change in mathematics and science education. Support for systemic change is also available from the mathematics and science research centers and regional laboratories operated by the DoEd's Office of Educational Research and Improvement, and from the Urban Superintendents' Network.

Underrepresented Groups in Mathematics, Science, and Engineering

The DoEd and the NSF will coordinate their efforts to improve mathematics, science, engineering, and technology education for traditionally underrepresented groups. Under the Comprehensive Regional Centers for Minorities in Science and Engineering of the NSF and the Minority Science and Engineering Programs of DoEd, mechanisms will be established to ensure that collaborative efforts serve to leverage the resources committed by each agency, increase the probability of synergistic cooperation, and minimize program duplication.

Programs to Improve Coordination in Undergraduate Education in Mathematics and Science, Including the Preparation of Teachers

For an increased undergraduate mathematics, science, and engineering education effort, mechanisms will be established for co-funding of projects by the DoEd Fund for the Improvement of Postsecondary Education (FIPSE) and the Division of Undergraduate Science, Mathematics, and Engineering Education of NSF. Programs will build on DoEd's and NSF's current work in this area. For example, support for Historically Black Colleges and Universities (HBCU) is a common goal of both DoEd and NSF. Strong coordination will be developed between the DoEd programs supporting research skills among faculty and upper level undergraduate students and the NSF undergraduate programs.

Study of Possible Impediments to Coordination

Both DoEd and NSF operate their programs under legislation that presumes that each has a primary responsibility for mathematics and science education. Both agencies agree that this can result in operating problems, problems working with the States, and even very real perceptions, at some levels, of actual barriers to coordinating and integrating programs. Both agencies agree that a major aspect of their renewed commitment to cooperation will be the joint review of legislation and program regulations to identify specific problem areas and to propose solutions.

The Long Term: Federal Coordinating Council on Science, Engineering, and Technology

The specific activities the DoEd and NSF will coordinate in the immediate future, described above, should be understood in the context of the larger effort to coordinate activities across the government. Recognizing the need for coordination among all Federal agencies with mathematics and science education programs, the Director of OSTP, as Chairman of the Federal Coordinating Council on Science, Engineering, and Technology (FCCSET), is taking steps to create a FCCSET Committee to deal with human resources and education. The Committee will be organized in time to coordinate the development of the 1992 budget submissions by the agencies.

This FCCSET Committee will include senior policy-level officials from DoEd and NSF, as well as from other Federal agencies with programs related to education and human resource development in science and technology. The Committee's work will promote more efficient use of expertise in the agencies, reduce program overlap, identify areas of program need, and make more efficient use of limited Federal resources. The objective of this new FCCSET Committee is to develop a truly integrated inter-agency effort in:

- strengthening mathematics, science, engineering, and technology education at all levels; and
- developing and maintaining a technologically and scientifically literate workforce to keep the nation competitive in global markets.

The new and revitalized FCCSET structure will benefit from the work of the President's Council of Advisors on Science and Technology (PCAST). The purpose of PCAST and its ad hoc panels of private sector executives, researchers, and academics is to advise the President on matters involving science and technology. The President's Science Advisor, as Chairman of both PCAST and FCCSET, will ensure that the FCCSET Committee receives the advice and recommendations of experts outside of government. Because education and human resources are issues that necessitate both public and private sector action, and cut across Federal, State, and local boundaries, the issues will be most effectively addressed by the FCCSET when it has access to the best private sector advice available.

TESTIMONY OF SUE KEMNITZER

FORMER EXECUTIVE DIRECTOR

TASK FORCE ON WOMEN, MINORITIES AND THE HANDICAPPED IN SCIENCE AND TECHNOLOGY

BEFORE THE UNITED STATES SENATE
COMMITTEE ON GOVERNMENT AFFAIRS

JUNE 14, 1990

MR CHAIRMAN AND MEMBERS OF THE COMMITTEE:

I BEGIN BY EXTENDING MY THANKS TO YOU FOR HOLDING HEARINGS ON THE TOPIC OF COORDINATING FEDERAL PROGRAMS IN SCIENCE, MATHEMATICS AND TECHNOLOGY EDUCATION. AS YOU KNOW, OUR NATION CANNOT AFFORD TO ALLOW THE MATHEMATICS AND SCIENCE PREPARATION OF OUR YOUNG PEOPLE TO CONTINUE TO SLIP IN QUALITY. BOLD CONCERTED EFFORTS ON THE PART OF ALL SEGMENTS OF OUR SOCIETY ARE NEEDED TO PRODUCE HIGHER QUALITY AND QUANTITY OF SCIENTISTS, ENGINEERS, AND TECHNICALLY COMPETENT WORKERS. YOUR LEGISLATION, S. 1951, WHICH WOULD CREATE AN INTERAGENCY COUNCIL ON SCIENCE, MATHEMATICS AND TECHNOLOGY EDUCATION, ADDRESSES THE NEED TO COORDINATE AND REVIEW THE FEDERAL COMPONENT OF OUR NATIONAL EFFORTS TO IMPROVE OUR SCIENCE AND MATHEMATICS EDUCATION FOR ALL STUDENTS.

LET ME STOP FOR A MOMENT AND EXPLAIN THAT I HAVE JUST BEEN INVOLVED IN AN INTERAGENCY EFFORT WHICH AMY BE DESCRIBED AS A PRECURSORY TO THE COUNCIL, NAMELY THE TASK FORCE ON WOMEN, MINORITIES, AND THE HANDICAPPED IN SCIENCE AND TECHNOLOGY. THIS GROUP WAS ESTABLISHED BY LEGISLATION SPONSORED BY SENATOR ORRIN HATCH BACK IN 1986. OUR PURPOSE WAS TO RECOMMEND HOW TO BROADEN PARTICIPATION IN SCIENCE AND TECHNOLOGY, PARTICULARLY BY THOSE TRADITIONALLY

UNDERREPRESENTED IN THESE FIELDS, ESPECIALLY WOMEN, MINORITIES AND PEOPLE WITH DISABILITIES. WE WERE COMPRISED OF THE TWELVE FEDERAL AGENCIES MOST CONCERNED WITH SCIENCE AND TECHNOLOGY OR WORKFORCE ISSUES, AND SEVERAL REPRESENTATIVES OF BUSINESS, EDUCATION AND PROFESSIONAL SOCIETIES. I THINK EVERYONE WOULD AGREE THAT THE WORKING RELATIONSHIP AMONG THE FEDERAL AGENCIES ON THE TASK FORCE WAS FOR THE MOST PART VERY CORDIAL AND EXCEEDINGLY PRODUCTIVE.

THIS WAS ONE OF THE REASONS WHY THE TASK FORCE INCLUDED WITHIN ITS RECOMMENDATIONS A CALL FOR THE ESTABLISHMENT OF A COMMITTEE WITHIN THE OFFICE OF SCIENCE AND TECHNOLOGY TO PROVIDE VISIBILITY, COORDINATION AND ACCOUNTABILITY FOR FEDERAL AGENCY PLANS TO STRENGTHEN SCIENCE AND ENGINEERING EDUCATION. IN SHORT THE AGENCIES WANTED TO CONTINUE TO HAVE A FORUM TO FACILITATE THEIR COLLABORATION.

AT THE TIME THAT WE ISSUED OUR FINAL REPORT ENTITLED "CHANGING AMERICA: THE NEW FACE OF SCIENCE AND ENGINEERING", DR. BROMLEY THE DIRECTOR OF THE OFFICE OF SCIENCE AND TECHNOLOGY POLICY ISSUED A STATEMENT ENDORSING THE TASK FORCE WORK AND ANNOUNCING HIS COMMITMENT TO ESTABLISH A FEDERAL COORDINATION COMMITTEE FOR SCIENCE, ENGINEERING AND TECHNOLOGY (FCCSET) TO CONTINUE TO FOCUS THE FEDERAL AGENCY ACTIVITIES IN EDUCATION AND HUMAN RESOURCE ISSUES. INDEED, AS YOU KNOW, HE DID ESTABLISH SUCH A GROUP AND THE SECRETARY OF ENERGY, ADMIRAL WATKINS, HAS AGREED TO SERVE AS ITS CHAIRMAN. I HAVE FULL CONFIDENCE THAT THIS GROUP UNDER THIS LEADERSHIP WILL PROVIDE THE BOLD AND CONCERTED EFFORT THAT IS NEEDED TO REACH OUR NATIONAL GOAL OF RAISING OUR STUDENTS

MATHEMATICS AND SCIENCE PERFORMANCE TO BE THE BEST IN THE WORLD IN THE YEAR 2000.

HOWEVER I NOTE THAT OUR GOAL SETS OUR SIGHTS ON THE YEAR 2000 AND I CAUTION THAT TO ACHIEVE THAT GOAL WE WILL NEED TO SUSTAIN THIS REFORM EFFORT OVER THAT TEN YEAR PERIOD (AND BEYOND FOR THAT MATTER). WILL WE HAVE PEOPLE IN LEADERSHIP POSITIONS WHO VALUE THIS EFFORT AS DR. BROMLEY AND SECRETARY WATKINS DO? HOPEFULLY, YES. BUT PRUDENCE WOULD DICTATE THAT WE INSTITUTIONALIZE THEIR LEVEL OF EFFORT IN ORDER TO BETTER ASSURE THAT THEY WILL BE CONTINUED EVEN WITH A CHANGE IN LEADERSHIP.

IF I MIGHT MAKE A SOMEWHAT STRAINED ANALOGY TO FOREIGN AFFAIRS. THE TIME FOR MAKING TREATIES AND AGREEMENTS WITH OTHER NATIONS IS WHEN RELATIONS WITH THOSE COUNTRIES ARE ON GOOD TERMS. THIS ALLOWS YOU TO CODIFY OR INSTITUTIONALIZE THE POSITIVE POINTS ON WHICH YOU CAN AGREE. LIKEWISE I SUGGEST THAT NOW IS THE TIME TO INSTITUTIONALIZE THE GOOD WORKING RELATIONSHIPS WE HAVE AMONG THE FEDERAL AGENCIES. IN OTHER WORDS, LET'S TRY TO ESTABLISH THIS TYPE OF COOPERATION AS THE STANDARD TO BE MET OR EXCEEDED IN FUTURE ADMINISTRATIONS.
MAY I ASK THAT THE REPORTS OF THE TASK FORCE, "CHANGING AMERICA: THE NEW FACE OF SCIENCE AND ENGINEERING" AND THE FEDERAL AGENCIES STATEMENTS OF ENDORSEMENT BE INSERTED IN THE RECORD.

FINALLY, ALTHOUGH I AM SURE THAT IT IS CLEAR TO ALL OF YOU, I WOULD LIKE TO CLOSE BY NOTING THAT OUR NATION'S GOAL TO IMPROVE SCIENCE AND MATHEMATICS FOR ALL OF OUR STUDENTS CAN ONLY BE MET IF ALL SEGMENTS OF OUR COUNTRY WORK TOGETHER TO ACHIEVE IT. SO I WOULD

SUGGEST THAT IN ADDITION TO BETTER COLLABORATION AMONG FEDERAL AGENCIES WE STRIVE FOR MORE LIVELY PARTNERSHIPS AMONG STATE AND LOCAL GOVERNMENTS, BUSINESS, EDUCATORS, ETC. FOR WE ALL HAVE A TREMENDOUS STAKE IN THE RESULTS. FOR I BELIEVE THAT OUR INTERNATIONAL COMPETITIVENESS, NATIONAL SECURITY, AND OVERALL QUALITY OF LIFE ARE DEPENDENT UPON THE MATHEMATICS AND SCIENCE SKILLS OF OUR WORKFORCE, AND ULTIMATELY UPON THE SCIENCE AND MATHEMATICS PREPARATION WHICH WE GIVE OUR STUDENTS. WE ARE SHORTCHANGING THEM AND OURSELVES IF WE PROVIDE THEM WITH LESS THAN THE BEST!

FEDERAL COORDINATION IN SCIENCE AND MATH EDUCATION

TESTIMONY OF JOHN ANDELIN
Assistant Director
Science, Information and Natural Resources Division

Office of Technology Assessment
Congress of the United States

Presented to the
Committee on Governmental Affairs
United States Senate

June 14, 1990

Mr. Chairman, it is a pleasure to appear before your Committee today on behalf of the Office of Technology Assessment to share some thoughts on science and mathematics education.

Introduction

Over the last few years, OTA has examined many aspects of the Nation's education and training needs and opportunities, including a broad-ranging examination of the issues surrounding Federal efforts in science and mathematics education. Our principal study, *Educating Scientists and Engineers -- Grade School to Grad School*, was completed in 1988. We believe its conclusions remain valid today. OTA emphasized that we must understand that education is "all one system" if we are to educate our citizens in science and engineering -- starting early in grade school, and, as appropriate, continuing into and beyond graduate school. We must enlist the efforts of both the traditional and the informal educational system -- industry, families, and individual citizens -- as well as government at all levels.

OTA strongly supports the proposition that the Nation is well advised to seek an adequate supply of people prepared for science and engineering. Although comprising only 4 percent of American workers, scientists and engineers have specialized skills that are vital to the national welfare. Others trained in these fields but not actively employed in research or product development also contribute to our national well-being. A solid education in the basics of science and mathematics enhances the value of all members of the work force and all participants in the democratic process.

OTA recognized that demographic trends signal a change in the production of scientists and engineers in the 90s -- we'll either have fewer of them, or a larger fraction will be women and minorities, groups not historically well-represented in these fields. We concluded that predicting the

balance between future demand for scientists and engineers, career shifts or existing scientists and engineers, and the production of new ones is uncertain at best. While we would argue that a shortage of scientists and engineers in the 90s is not inevitable, we believe that, as in any labor market, transitory shortages in specific fields are unavoidable; and, most important, we concluded that, regardless of projections of supply and demand, the value of preparing a cadre of versatile students capable of research and teaching is such that the Federal Government needs to play a more active role. This can be done by investing in many ways in an educational system, both formal and informal.

Federal Role in Science and Engineering Education

Federal involvement in this issue has historically been focused at the graduate school level, but there are many choices for action throughout the system. Some Federal options falling under three major headings -- recruitment, retention, and strengthening of Federal science and engineering education efforts -- were identified in our study and are shown in Attachment A. While respecting the traditional control of education vested in the nation's states and localities, the Federal Government can effectively strengthen strategies for recruitment of students into these critical fields, and retention of students toward professional degrees. And it can certainly coordinate its efforts better.

Retention strategies -- keeping more students in science and engineering -- offer the quickest way to produce more workers. Because only 30% of those who graduate in science and engineering enter full-time graduate study, a relatively small increase in retention at that level could increase significantly the number of M.S. and Ph.D. scientists and engineers. Funding assistance and programs to attract students to graduate work can easily be devised, mostly by expanding or building upon existing efforts. Similarly, targeted support for undergraduate science and engineering students, various forms of hands-on research experience, and institutional support of research colleges and universities and historically Black colleges and universities will help retain scientists and engineers at the baccalaureate level.

Recruitment, however, is a long-term strategy, designed to enlarge the base of potential scientists and engineers by recruiting more and different students. There are two demonstrably successful ways to recruit young people: offer special science and mathematics educational enrichment programs tailored to selected students, and give all students good, enthusiastic classroom and laboratory experience. An important arena of lively innovation is informal education -- science museums, television programs, camps, and other experiences outside the formal school system.

Federal Interagency Coordination

Specifically relevant to today's hearing, *Grade to Grad* noted that Federal coordination in science and mathematics education was lacking. In it, OTA suggested, among other things, that the level and visibility of interagency planning and coordination be raised (see the excerpt from *Grade to Grad* -- Attachment B). The formation of an Interagency Council on Science, Mathematics, and Technology Education would clearly be such a move, as is the recent formation of a FCCSET Committee on Education and Human Resources.

As noted in our report and in the legislation being considered today, formation of a Federal coordinating body is not itself the end we seek. The responsibilities of such a body, and the measures by which we might evaluate its success, can only be defined once national goals and the Federal role in achieving those goals are themselves established. Nevertheless, some issues come immediately to mind.

Either the FCCSET Subcommittee or the proposed Interagency Council will need to come to grips with the exact nature of agency participation. What will each agency undertake to do? How will the responsibilities for data standardization, collection, and analysis be treated? Will one agency be responsible for this? What mechanism assures that others will cooperate? And what are the data to be used for?

The legislation calls for data to be collected on "duplications," among agencies. Duplications, in fact, can be easily eliminated, and in some cases may provide a healthy redundancy. More important, some data are sadly missing: A set of output measures needs to be constructed to gauge progress toward the education goals established by the President and the Governors, the FCCSET committee, or any other body. We need a way to calibrate outcomes, to measure how rapidly we are achieving them, and to determine how much each agency is contributing.

Important decisions must predate the creation of the information base. Is the analysis primarily for providing feedback to the agencies directly, shaping federal policy at OSTP, or informing the Congress? The Committee may want to request answers to these questions early on. Evaluation and assessment in education is never easy, and clarity up front about the purpose is crucial.

One might also ask the real purpose of the reporting requirement. We are all too familiar with reports to the Congress that are never delivered, delivered late, or delivered and unread. They only add to our paper flow. But a report that measures progress towards national goals, and shows how much each agency is contributing could be different. In today's climate of concern for education, such a report would be eagerly awaited -- and the promise of action could follow its release.

Equally important, one might ask to whom the Interagency Council or the FCCSET Committee should report. Presumably, the proposed Interagency Council would report to the Congress, while FCCSET reports to and is part of OSTP.

As part of the stepped-up level of action, this Committee might consider encouraging all Federal research agencies to formally specify education as a part of their mission. Secretary Watkins' willingness to do this has been crucial to the vigorous work now underway all across the country supported by the Department of Energy. Recognition of the importance of education activities could help each Department develop its education efforts, and reward employees who engage in them.

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With regard to reporting to Congress and stimulating internal review, OTA suggests that the Committee explore the pros and cons of charging PCAST with the responsibility for evaluating the work of either group. It would seem that having PCAST play this role would keep the coordinating efforts in high profile, and would ensure a thorough analysis.

OTA hopes that whatever group comes into being to coordinate and strengthen the Federal effort, it is seen as just a beginning. Education and the development of human resources, for science, engineering and the nation's work force, is a continuing effort. It requires a sustained, committed Federal presence ... and more.

ATTACHMENT A

Policy Options To Improve Science and Engineering Education

Recruitment—Enlarge the Pool

- *Elementary and secondary teaching*: encourage and reward teachers; expand support for preservice and inservice training.
- *School opportunities*: reproduce science-intensive schools; adjust course-taking and curricula; review tracking; and revise testing.
- *Intervention programs*: increase interest in and readiness for science and engineering majors; transfer the lessons from successful programs; encourage sponsorship from all sources.
- *Informal education*: increase support of science centers, TV, fairs, and camps.
- *Opportunities for women*: enforce Title IX of the Education Amendments of 1972 and provide special support and intervention.
- *Opportunities for minorities*: enforce civil rights legislation and provide special support and intervention.

Retention—Keep Students in the Pool

- *Graduate training support*: "buy" Ph.D.s with fellowships and traineeships; these people are most likely to join the research work force.
- *Academic R&D spending*: bolster demand and support research assistants, especially through the mission agencies.
- *Foreign students*: adjust immigration policy to ease entry and retention.
- *Undergraduate environments*: support institutions that reward teaching and provide role models, such as research colleges and universities, and historically Black institutions.
- *Hands-on experience*: encourage undergraduate research apprenticeships and cooperative education that impart career skills.
- *Targeted support for undergraduates*: link need- or merit-based aid to college major.

Strengthen Federal Science and Engineering Education Efforts

- *National Science Foundation as lead science education agency*: underscore responsibility through the Science and Engineering Education Directorate for elementary through undergraduate science programs.
- *Federal interagency coordination and data collection*—raise the visibility of science education and the transfer of information between agencies and to educational communities.

Improve Federal Interagency Coordination and Data Collection

Coordinating related programs among Federal agencies is a perennial problem in all mission areas, not just education and research. To facilitate coordination, information sharing, and to avoid fruitless duplication, Congress has mandated various forms of organized consulting mechanisms, such as interagency coordinating committees. Ad hoc, informal communication among colleagues—telephone calls, meetings, etc.—is as important as formal communications. Coordinating committees have been most commonly used in areas undergoing significant change, such as areas of new Federal involvement and regulation, or with important public or foreign policy interest (such as biotechnology). In science and engineering education, there seems to be no such motivation for extensive formal coordination. Congress could change the tone, if not the motivation, for interagency coordination.

Using the unique aspects of the education programs sponsored by the mission agencies could be an essential part of coordination. Regional laboratories and centers often develop close ties to local schools and universities. Mission R&D has an inherent attraction to youngsters (for example, space, aeronautics, and nuclear power) lacking in the basic research that NSF funds. The mission agencies also monitor and analyze their personnel needs, as in the Department of Energy-supported data series on energy-related manpower. (Although not a Federal agency, the Institute of Medicine likewise sets a high standard with its analysis of biomedical and behavioral research personnel supply and demand.)[28] Such planning may be easier to do in a narrow, applications-oriented field than for science and engineering as a whole.

Mission agencies should have the authority and funds to capitalize on their strengths, including science education. Often they must scavenge education money from research programs. NSF is needed to ensure the renewal of the research work force for basic, long-term research; the mission agencies need to handle their shorter-term, more volatile science and engineering personnel needs.

There is also no comprehensive and systematic summary of all Federal science and engineering education programs. Many Federal agencies involved in scientific and engineering activities have education programs, but these programs are not centrally coordinated. The National Science Foundation collects and publishes reliable data on the funding provided by each Federal agency for R&D at universities and for support of graduate students. These data also include funding for instructional equipment. Although NSF has historically been the lead agency for science and engineering education programs, more funds for such programs are provided by NIH than by NSF.

- Raise the level and visibility of interagency planning and coordination of science and engineering education programs. Foster informal exchanges of ideas and information among NSF, the Department of Education, and the mission agencies. Establish a Federal coordinating committee on science and engineering education among these agency representatives.
- Attach higher visibility to science and engineering education programs (and possibly expand them) in R&D mission agencies by requiring reports or by giving such education programs line items in budget proposals.
- Require NSF to assemble a biennial report on the overall state of Federal programs in science and engineering education. Or ask the Office of Management and Budget to do a special budget analysis on Federal science and engineering education, which would tabulate the net result of all types of programs, categorized by level of education and the destination of funding (including students, faculty, and institutions).
- Support data collection, analysis, and dissemination at the Department of Education and NSF, especially longitudinal studies.
- Redivide NSF and Department of Education data responsibilities by mandating reports, allotting budgets, and requiring the Department to collect science and engineering education data.
- Continue to revamp the National Center for Education Statistics.[29]
- Improve the use of education data, in particular, information dissemination and technology transfer of successful research and practice. Expand the Department of Education's National Diffusion Network and support networking efforts (through agency funding of newsletters, professional societies, and conferences).

[28] U.S. Department of Energy, *Energy-Related Manpower 1986* (Washington, DC: annual); and Institute of Medicine, *Personnel Needs in the Biomedical and Behavioral Sciences 1987* (Washington, DC: biennial).

ATTACHMENT B

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COORDINATION OF PROGRAMS ON MATHEMATICS AND SCIENCE EDUCATION FOR THE DEPARTMENT OF EDUCATION, THE NATIONAL SCIENCE FOUNDATION, AND OTHER AGENCIES

This report responds to language in the House of Representatives and the Senate Labor, Health and Human Services, and Education Appropriations Subcommittees' reports on the FY 1990 appropriation regarding mathematics and science education programs administered by the Department of Education (ED). The House Committee requested a report that would detail "efforts to coordinate math and science programs with those of the National Science Foundation (NSF)." The Senate requested a report, "which reviews the present efforts of the Department to coordinate its activities in the areas of math and science education with other Federal agencies, particularly the NSF, and a strategy to enhance such coordination in the future."

The report is organized into three sections. The first section describes the collaborative efforts that are currently underway. The second section discusses the history of ED's science and mathematics education collaboration, with special emphasis on the collaborative efforts with NSF. The final section presents some topic areas and programs that have potential for future agency collaboration.

CURRENT COLLABORATIVE EFFORTS

The issue of collaboration regarding math and science education has received considerable attention this past year, which has led to establishment of some highly significant structures and relationships in the past several months. Perhaps the most significant step has been the formation of an Education and Human Resources Committee under the Federal Coordinating Council for Science, Engineering, and Technology (FCCSET). The President's Science Advisor, Dr. Bromley, has appointed Secretary of Energy Watkins as Chair, with the Under Secretary of Education and the Senior Science Advisor of NSF as Vice Chairs. This Committee will encourage and coordinate Federal programs and policies related to science, mathematics, engineering, and technological education, training, and human resource development.

In addition to the FCCSET Committee, the Secretary of Education and the Director of the NSF have established formal mechanisms for coordination of mathematics and science education programs between the two agencies. The Director of NSF appointed his Senior Science Advisor (Luther S. Williams) to chair NSF's coordination effort. The Assistant Secretary for Educational Research and Improvement (Christopher T. Cross) has been charged with the coordination effort for ED. Coordination at all

appropriate levels between ED and NSF is the continuing responsibility of these high-level officials. These new coordination efforts replace earlier ad hoc coordination arrangements.

Collaboration of the two agencies under this mechanism has already reached beyond coordination to the development of cooperative initiatives and relationships. Areas in which there are agreements to collaborate (subject to receipt of positive peer reviews) include:

- Joint funding of the American Association for the Advancement of Science "2061" Phase II curriculum development projects. These projects are designed to develop alternative curricular strategies to achieve the learning goals described in the AAAS/Project 2061 report "Science for All Americans."

- Joint funding of core support for the National Academy of Science's Mathematical Sciences Education Board. MSEB was created with the full backing of the mathematics and mathematics education community to encourage the reform of mathematics education throughout the country. Its report "Everybody Counts" lays out a broad strategy for change that will be national in scope. A senior ED official served on the committee reviewing the MSEB proposal.

- Joint funding of educational television programs.

In addition to these joint funding efforts, agreements have been reached on the following means to enhance collaboration.

- NSF is developing appropriate protocols for their materials and exemplary teacher professional development projects so that they can be shared through the Department's dissemination networks, such as the National Diffusion Network, regional laboratories, and technical assistance centers.

- The Department's Eisenhower Mathematics and Science Education program at the State and local levels will continue to support teacher participation in NSF teacher enhancement projects.

- The Department plans to implement a new mathematics and science initiative under the Upward Bound program. Plans for this initiative are being coordinated with NSF and the National Programs component of the Eisenhower Mathematics and Science Education program.

- State and local education agencies making application to NSF for support under the systemic reform program are being

encouraged to use Eisenhower Act, Chapters 1 and 2, and Vocational Education funds to strengthen science and mathematics learning initiatives.

The Department of Education has also taken internal steps to foster collaboration and coordination. The Department has established a Task Force on Mathematics and Science Education, chaired by the Director of the Office of Research, that includes all operating units within the Department. The Task Force's task is to compile a comprehensive compendium of Department science and mathematics activities that will provide the information necessary to increase coordination with other agencies. This report is due June 30, 1990. The Task Force will also be exploring means of improving coordination with other agencies. In addition to all of the Department's offices, NSF and members of OSTP, Energy, NASA, NAS, and other agency staff meet with the Task Force.

HISTORY OF COLLABORATION

Background

The Department of Education and the National Science Foundation share a deep concern for the improvement of science and mathematics education in this country and each has pursued a mission to carry this out. At times the two agencies have supported similar activities, while at other times the efforts have been complementary. Both NSF and the U.S. Department of Education have supported major curriculum development. NSF's science projects, such as Biological Sciences Curriculum Study, Science Curriculum Improvement System, and Science: A Process Approach are justifiably renowned. Education's math projects, such as Comprehensive School Mathematics Program and Developing Mathematical Processes, are also held in the highest regard in the mathematics and science education communities. Both agencies have also supported research on teaching and learning processes for mathematics and science. For example, NSF funded the research on teacher "wait-time," while Education was responsible for the research on student misconceptions in science. Such projects are examples of a healthy, multi-faceted R&D system searching for the best ideas wherever they might be found.

Limited resources also require that redundancies and duplication across agencies be kept to a minimum. While there has never been an official division of responsibilities between the agencies, there have been attempts to establish such distinctions. When the Department of Education was created in 1979, an effort was made to carefully distinguish efforts of the two agencies. This resulted in the transfer from NSF to the Department of Education of the Minority Science Improvement

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Program and the equivalent of the elementary education portion of the Teacher Institutes Program.

There are differences in both the missions and procedures of Education and NSF. However, most of these should be seen as differences in emphasis rather than categorical distinctions.

MISSION DIFFERENCES

1. o NSF was established to promote and advance mathematics and science (which includes engineering, technology and the social sciences). In any joint funding ventures focusing on broad topics, NSF can support only that portion addressing these disciplines.

   o The Department of Education was established to guarantee that students have equal access to the best possible education and to improve the quality of education for all students.

2. o Because of the pre-doctoral fellowship program and the research assistantships and associateships supported by research grants, NSF has a major presence in graduate education and postdoctoral education.

   o Because of the large formula grant programs addressing K-12 concerns and its student financial assistance programs, the Department has been more identified with pre-college and undergraduate education.

PROCEDURAL DIFFERENCES

1. o NSF's funds are all discretionary. Substantive directions are determined at the national level, under the guidance of peer review.

   o The Department's funds are predominately distributed by formula. Procedures are set at the national level, but substance is often determined locally.

2. o Traditionally, NSF has dealt with mathematicians, scientists, and math and science educators directly, to the extent possible.

   o The Department has more frequently dealt with state and local education agencies and institutions of higher education.

As an example, NSF sends reviewers' comments on research proposals directly to the Principal Investigator, while the Department routinely returns them to the institutional representative, who is in the institution's research office in many higher education institutions.

3. o In higher education, NSF's contacts are primarily with individuals in math and science departments.

   o The Department's contacts in higher education are more likely to be with college administrators, and with colleges of arts and sciences and education.

4. o NSF grants all of its awards "up front." A three-year award is granted completely from the current year's appropriation. Since each year's appropriation represents uncommitted funds, a major share of agency activity must be devoted to the processing and peer reviewing of proposals to commit those funds.

   o The Department usually funds in one-year increments, even for multi-year awards. Any year's appropriation is already substantially committed to continuations. A major share of agency activity must be spent on monitoring awards for continuation.

5. o In supporting project development, NSF puts strong emphasis on monitoring early, conceptual activities. Ensuring that projects contain "good science" is a central theme.

   o The Department is more likely to emphasize impact and use of any project it supports. Thus, outcome evaluations and dissemination have been topics of major concern for many years.

Previous Coordination Efforts

There are two different ways in which coordination occurs between the Department of Education and other agencies, particularly NSF -- communication and mutual planning, and joint funding. Although joint funding is a more visible sign of collaboration, it occurs through the many regular contacts between the agencies, particularly those at the program level.

A. Communication and Mutual Planning

Coordination and collaboration with other agencies, particularly NSF, have been occurring for many years. When the National Institute of Education was established in 1972, it had a designated science advisor who came from the staff of NSF. Cooperation with NSF has continued with the Department of Education.

The most obvious examples of current communication and mutual planning have occurred in relation to the Eisenhower Mathematics and Science Education Program. Department staff in the Office of Elementary and Secondary Education (OESE) administering the State Grants program have secured input and advice from the National Science Foundation, the Department of Energy, NASA, and other Federal agencies. NSF, DOE and NASA are represented on the National Steering Committee that Education has established to help give direction to the Eisenhower Program.

Other forms of communication have also been developed. For example, at the most recent Annual National Conference of the Eisenhower State Coordinators, NSF staff set up an exhibit, distributed documents, and were responsible for about a half-day of the conference program. OESE staff participate in NSF-sponsored conferences and review applications to NSF for programs of national significance.

For postsecondary education, regular communication occurs between Education and other agencies. Regarding the Minority Science Improvement Program, there is an informal task group involving NSF and several other agencies that meets to share information on support for science and technology. There are also regular informal discussions between Education and NSF regarding the Fund for the Improvement of Postsecondary Education, specifically on faculty development projects addressing math and science. This matches with NSF's initiative in faculty development.

For research, dissemination, and statistics, there are many instances of communication and mutual planning. Under Secretary Sanders spoke at NSF's Science and Engineering Education Directorate's Advisory Board meeting. Staff members of Education and NSF regularly serve as reviewers for one another's projects. Specific instances of collaboration between Education and NSF are also detailed in the following section.

B. Joint Funding

A long-standing relationship exists between the National Science Foundation and the U.S. Department of Education. The nature of this relationship has changed as the common interests of the agencies have evolved.

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NSF and the Department of Education have cooperated on a number of projects. For example, in 1977 NSF and the National Institute of Education jointly supported a competition that brought together natural scientists and cognitive psychologists for some of the early research on the cognitive structure of learning and instruction. Results of this research are now having major impacts in the classroom.

Among the most recognized examples of cooperation between Education and NSF are their joint funding of the following television series. These highly praised educational programs have been viewed by millions of children.

- Square One TV - A television series to supplement classroom mathematics education for children 8-12 years of age.
- 3-2-1 Contact - An Emmy-award winning children's science television series.
- Voyage of the Mimi - An integrated math, science, and technology program for the upper elementary grades.

Many of the recent joint funding efforts have occurred between the NSF and the National Center for Education Statistics. Because of the intense interest in reform and accountability, data collection aimed at illuminating the status of science and mathematics education at the national level has provided many opportunities for mutually beneficial projects.

1. Analysis of National Education Longitudinal Studies Data

   NCES co-funded with the NSF analytic studies on: 1) Systemic Analysis of School and Community; 2) Student Engagement in Learning; 3) Student Subcultures; 4) Outcomes for Low Performing Students; and 5) NELS:88 Research Information Management System. (Dollar figures represent Department of Education contribution).

   Funding: FY 1989 - $300,000
   FY 1990 - 142,000

2. ASA/NCES/NSF Research Fellows Program

   NCES augmented the NSF grant to the American Statistical Association to bring academic statisticians to NCES to conduct research studies using NCES data bases.

   Funding: FY 1989 - $40,000

B

3. Second International Science Study (IEA)

NCES joined NSF to support Columbia University's conduct of an analysis of the Second International Science Study.

Funding: FY 1988 - $ 40,000
FY 1989 - $ 100,000

4. International Assessment

NCES and NSF supported the Educational Testing Service's (ETS) conduct of a comparative study of mathematics and science achievement of 13-year-olds in five countries: Korea, the United Kingdom, Spain, Canada (three provinces-Quebec, Ontario, New Brunswick), and the United States.

Funding: FY 1988 - $150,000
FY 1989 - 170,547

5. International Assessment

NCES and NSF jointly funded ETS' conduct of a second international assessment of the mathematics and science achievement of 13-year-olds in 20 countries. Most countries will participate in an optional geography probe and about two-thirds will participate in an experimental performance assessment of 13-year-olds. Additionally, an assessment of 9-year-olds in mathematics and science will be implemented by about two-thirds of the participants.

Funding: FY 1990 - $250,000

6. Annual Survey of Earned Doctorates

NSF joined NCES in the collection of data on earned doctorates in all disciplines.

Funding: FY 1989 - $156,000
FY 1990 - 156,000

7. Board on International Education Studies

NCES and NSF are providing support to the National Academy of Sciences (NAS) to develop specific recommendations for a permanent international framework to coordinate international assessments that would compare the performance of U.S. students in mathematics and science to that of their counterparts in other industralized nations.

Funding: FY 1988 - $75,000
FY 1989 - 85,000
FY 1990 - 75,000

8. State-Based Network to Develop Science and Mathematics Indicators

   NCES and NSF jointly funded the Council of Chief State School Officers to develop a Teacher Supply and Demand Model in seven northeastern states.

   Funding: FY 1989 - $ 66,000
            FY 1990 - 161,140

9. Committee on National Statistics

   NCES is one of the several Federal agencies that support the core activities of the Committee on National Statistics of the National Academy of Sciences. The National Science Foundation coordinates the activities of the Committee.

   Funding: FY 1989 - $75,000
            FY 1990 - 30,000

10. National Education Longitudinal Study of the Eighth Grade Class of 1988 (NELS:88)

    NSF augments NCES' Teacher Supplement to the NELS:88 to collect information on math and science teachers.

    Funding: FY 1986 - $115,000
             FY 1987 - 175,000
             FY 1988 - 175,000
             FY 1989 - -0-
             FY 1990 - 499,954

The Office of Research and NSF also jointly funded an analysis of transcripts of college students to determine the amount of science and mathematics coursework that they had taken. The specific task in this study was to develop a viable taxonomy of course categories in science and engineering fields.

There are also some less direct but nonetheless important ways in which the two agencies have cooperated on joint funding. A number of curriculum projects developed under NSF support are now being disseminated through Education's National Diffusion Network. This provides a means through which promising programs can be disseminated to a broader audience, and provides for leveraging of NSF's substantial initial investment in these projects. Life-Lab, Mechanical Universe, Sci-Math, and Informal Science Study are examples of NSF-originated projects that have become part of NDN. Similarly, NSF has supported regional teacher training programs that have drawn upon these and other NDN projects.

NSF has also funded a number of projects in the national R&D Centers that the Office of Research supports.

- The Center for the Study of Learning at the University of Pittsburgh, in conjunction with the American Federation of Teachers, is synthesizing new knowledge on mathematics learning and instruction, transforming this knowledge into practical materials, and disseminating these materials to the field.

- The Center for Policy Research in Education at Rutgers University is studying the content of mathematics and science courses that high school students are taking as a result of education reform. This is an extension of earlier work that found students' course taking has increased, but that usually these courses cover rudimentary math and science.

- The National Center for Research in Mathematical Science Education at the University of Wisconsin-Madison and the National Center for Improving Science Education at the Network, Inc. are also examples of efforts funded by both NSF and ED. Much of the research being conducted at the math center is based on a model for research and curriculum development called "Cognitively Guided Instruction" developed by Fennema, Carpenter, and Peterson with funding from NSF. Likewise, the science center is partly an outgrowth of a study on the dissemination of science curricula carried out by the science center for NSF.

TOPICS FOR POSSIBLE FUTURE COORDINATION

As discussions proceed between the Department of Education, NSF, and other agencies, there are other areas in which collaboration might occur. Following is a list of topics that have promise for joint efforts.

A. USE OF U.S. DEPARTMENT OF EDUCATION DISSEMINATION NETWORKS TO PUBLICIZE PROJECTS AND THE RESULTS OF JOINTLY SUPPORTED ED-NSF PROJECTS.

The following are examples of Department of Education networks that could be used to disseminate information on NSF-funded materials development projects and resulting materials.

Office of Educational Research & Improvement (OERI)

The Urban Superintendents' Network

OERI, through its Programs for Improvement of Practice, supports a network of urban superintendents of schools--the network can serve as an important conduit of information to large inner-city school systems.

National Diffusion Network (NDN)

The NDN is organized to disseminate promising curricula in all school subjects; a significant portion of these projects concerns mathematics, science, and technology. Currently NSF has funded the COSMOS Corp. to identify "well-documented" exemplary NSF-supported projects. This effort could be expanded to include promising materials development projects that have been field-tested in schools and school systems.

Regional Education Laboratories

The nine regional labs supported by OERI are designed to provide technical assistance to States and local education agencies. Many conduct workshops, issue publications, or provide technical assistance to improve instruction in mathematics and science. The Labs could be encouraged to expand their math and science efforts and to emphasize NSF-generated materials.

Eisenhower National Programs

The Eisenhower Act National program participates in joint meetings of Eisenhower State mathematics and science coordinators and Eisenhower National Programs project directors. These meetings could be co-sponsored by ED and NSF to join together in making innovative materials, innovative learning technologies, exemplary practice, and salient research available to participants.

The Education Resources Information Center (ERIC)

ERIC is a national system of clearinghouses that share research results and exemplary practices through publication references and special reports. Most clearinghouses provide information relevant to mathematics, science, and technology education; however, the Clearinghouse for Science, Mathematics, and Environmental Education (Ohio State University) focuses explicitly on these areas. This Clearinghouse works with over 30 national associations and more than 200 Federal, State, and local school agencies and organizations. All of the Clearinghouses could be

encouraged to prepare syntheses and publications on mathematics, science, and technology relative to their missions that draw on NSF generated research and materials.

Office of Elementary and Secondary Education (OESE)

CHAPTER 1

Much of Chapter 1 funding supports mathematics instruction. State and local administrators are familiar with a variety of effective instructional programs in mathematics, science, and technology. Chapter 1 projects frequently are part of networks of administrators, parents, and teachers. These groups could be important conduits of knowledge about exemplary practice and innovative materials, such as from NSF-funded projects.

EISENHOWER STATE GRANTS PROGRAM

Grants to local school systems and to institutions of higher education to work in partnership with local schools and teachers could include a documentation and dissemination component focused on exemplary programs and the use of technology.

Office of Vocational and Adult Education (OVAE)

NCRVE

The National Center for Research on Vocational Education (NCRVE) at the University of California-Berkeley has a significant dissemination responsibility that could include NSF-supported efforts.

B. R&D ON EFFECTIVE LEARNING, TEACHING, SCHOOL ORGANIZATION, AND POLICY; AND THE USE OF TECHNOLOGY FOR LEARNING AND TEACHING IN SCIENCE, MATHEMATICS, AND TECHNICAL EDUCATION

OERI

National Research and Development Centers

Many of the 26 Research and Development Centers supported by the Department's Office of Research (in OERI) focus on issues that are important to mathematics, science, and technology education. The following Centers place special emphasis on these areas:

- The National Center for Research in Mathematical Sciences Education (The University of Wisconsin-Madison)
- The National Center for Improving Science Education (The Network, Inc., Andover, Massachusetts)
- The Center for Technology in Education (Bank Street College of Education in New York City)
- The Center for the Study of Learning (The University of Pittsburgh)
- The Center for the Learning and Teaching of Elementary Subjects (Michigan State University)
- The National Center for Research on Teacher Education (Michigan State University)
- The Center for Policy Research in Education (Rutgers University, with partners at Stanford University, Michigan State University, and the University of Wisconsin-Madison)
- The Center for Research on the Context of Secondary School Teaching (Stanford University with partners at Michigan State University and the Rand Corporation)

The two agencies are currently discussing the funding of a project on mathematics education reform to be conducted by an existing center. In addition, NSF is considering the possibility of jointly funding and monitoring new centers in mathematics and science that are presently being competed and will begin operation in FY 1991.

The current collaboration between NSF and ED that contributes to the R&D programs of these Centers can be expanded and made more formal. ED will provide NSF with the technical proposals of these Centers so that NSF can help identify promising new areas for collaboration.

ED will provide NSF with information from programs such as the Fund for Innovation in Education (FIE) and the Vocational Education Technology Education Program, and NSF will likewise keep ED abreast of relevant programs.

C. ENHANCED ASSESSMENTS OF STUDENT ACHIEVEMENT

OERI

National Center for Education Statistics (NCES) administers the National Assessment of Educational Progress

One of the most important post-summit activities relating to the national education goals will be the development of appropriate national and international comparative assessments of student learning in science, mathematics, and related technical education. NSF and ED/NCES already have a strong track record of collaboration in national and international assessments. A major future activity will be to coordinate the needed research, experimentation, and trials of appropriate performance assessments, such as portfolios and related assessments, which measure authentic acquisition of knowledge, habits of mind, and skills related to science and mathematics.

Office of Research

The National Center for Research on Assessment, Testing, and Evaluation, the National Center for Research in Mathematical Sciences Education, the National Center for Improving Science Education, and a number of other Centers will have significant assessment projects. Details of these Centers' assessment-related projects will be provided to NSF to identify promising areas of collaboration. As discussed previously, possible collaboration activities involving new centers are being discussed with NSF.

D. PROGRAMS WITH STATES

ED will alert its State networks, such as the Eisenhower State coordinators, the NDN State facilitators, and the vocational education regional curriculum coordinators, that NSF is initiating a State network program. Our network facilitators will be asked to cooperate.

E. PROGRAMS FOR URBAN EDUCATION

Each of the following programs could be given incentives or strongly encouraged to work in collaboration with urban schooldistricts engaged in comprehensive, systemic education reforms focused on science, mathematics, and technological education--with a particular emphasis on underrepresented groups. These efforts are suitable for collaboration with NSF.

OERI

Office of Research

National Center on Education in the Inner Cities
National Center on Effective Schooling for the Disadvantaged
National Center on School Organization and Restructuring

Urban Superintendent's Network
LEAD Leadership Training Centers and State Leadership Training
Principal Training (proposed)

OESE

Chapter 1
Magnet Schools in Desegregating Districts
Magnet Schools of Excellence

F. **PROGRAMS TO IMPROVE COORDINATION IN THE AREA OF POSTSECONDARY EDUCATION IN SCIENCE AND MATHEMATICS, INCLUDING THE PREPARATION OF TEACHERS**

Both ED and NSF have substantial involvement in programs intended to strengthen the mathematics and science skills of postsecondary students, including prospective teachers. The following programs will be encouraged to work closely with NSF as they plan and carry out their work.

OERI

Office of Research

- National Center for Research to Improve Postsecondary Teaching and Learning, University of Michigan, Ann Arbor

- National Center for Research on Teacher Education, Michigan State University, East Lansing

Office of Postsecondary Education

- Minority Science Improvement Program (MSIP)

  Support for minority institutions, including Historically Black Colleges and Universities and other institutions whose enrollments are composed predominantly of underrepresented minorities, is a common goal of ED and NSF. Strong coordination between MSIP, which focuses on support for research skills among faculty and upper level undergraduate students, and the NSF research programs could be developed.

- Fund for the Improvement of Postsecondary Education (FIPSE)

  FIPSE supports projects in the development of teachers and teacher education. Stronger coordindation and jointly funded projects or competitions could be developed with the NSF teacher preparation program.

FIPSE also supports faculty and curriculum development projects that could be coordinated with NSF Instructional Laboratory Improvement projects, faculty enhancement and curriculum development projects.

- OPE supports graduate fellowships whose national priorities include the physical sciences and engineering. A closer working relationship between OPE and NSF's Division of Research Career Development could be established.

Response to Congressional Directive
House Report No. 101-172 and Senate Report No. 101-127

UNITED STATES DEPARTMENT OF EDUCATION

OFFICE OF THE ASSISTANT SECRETARY
FOR EDUCATIONAL RESEARCH AND IMPROVEMENT

June 14, 1990

Senator John Glenn
United States Senate
Washington, DC 20510-3501

Dear Senator Glenn:

I want to thank you for the excellent exchange that we were able to share at this the hearing on S.1951. It is refreshing to discuss these issues with someone who is both committed and open to new ideas. I was particularly pleased with your interest in and support for education research.

As I mentioned, my Office administers the education research, data collection, and most of the improvement programs for the Department of Education. We are currently holding competitions for 18 R&D centers and ten regional education laboratories. These will include a science teaching and learning center and a mathematics teaching and learning center. Each of these will be co-sponsored through a joint agreement with the National Science Foundation.

As promised, I am enclosing some materials on our programs. I would be pleased to meet with you to discuss our research priorities and gain your insights with regard to our efforts to reach the national education goals.

Sincerely,

Christopher T. Cross
Assistant Secretary

Enclosures

WASHINGTON, D.C. 20208

To Build the Best Schools in the World: Information from Education Research and Statistics

Christopher T. Cross
Assistant Secretary for Educational Research and Improvement
The Office of Educational Research and Improvement (OERI)
April 4, 1990

As we enter the 1990s, schools and States are embracing a host of reforms at a dizzying pace--school-based management, accountability for performance, curricula that promote higher-order thinking. With educational changes proceeding on multiple levels simultaneously, never has there been such an opportunity to learn about "what works" in educating youngsters. The question is, which changes will lead to actual improvements in learning?

Americans must have answers. There isn't time to reinvent the wheel in every school or community seeking to "restructure" education. Parents, educators, policymakers, and other stakeholders in this school or that community ought to benefit from and build upon the successes of their counterparts elsewhere.

This is where the Office of Educational Research and Improvement (OERI) comes in. As the main Federal agency for reporting on the "condition and progress of education" in the United States, OERI supplies various audiences with information from education research, statistics, assessment, and practice. We want to do a far better job. We want to increase the quality and availability of such information. We want to increase the number of Americans who use such information to improve teaching and learning in their schools, workplaces, and homes.

Our ability to do so will depend on our capacity to address a number of key issues and critical questions.

Early Childhood

o What can parents do to promote their child's physical, emotional, and intellectual growth from infancy on, and how can all parents, particularly low-income and hard-to-reach parents, be helped to do these things? (National Household Education Survey)
o How many children attend preschool, and what characteristics typify such programs? (various surveys)
o How can "readiness" to benefit from formal schooling be assessed? (research centers)

Completing High School

o Who drops out of school, when do these youngsters leave school,

and why? (National Education Longitudinal Survey: 1988)
o Which "education variables" can be altered so as to encourage more youngsters to persist and complete a quality education? (Dropout Prevention Initiative, Center on Effective Schooling for Disadvantaged Students, and other research)
o What educational approaches lead to optimal performance of inner city schools and students? (Center on Education in the Inner Cities)

Assessment

o How do American youngsters' achievements in mathematics, science, geography, and reading compare with their future international competitors? (international assessments)
o How can the National Assessment of Educational Progress (NAEP) be improved--that is, focused on more "authentic" higher-order tasks and expanded to furnish more State-comparable data on more academic subjects--while at the same time keeping the "test burden" on schools and students to a minimum?
o What existing assessment instruments and procedures can be modified and used by schools and States to gauge student and adult progress toward the higher-order competencies universally desired in workers and citizens? (Research Center on Assessment, Evaluation, and Testing)

Teaching, Learning, and Leadership

o What are the common roadblocks to acquiring competence in critical disciplines--mathematics, science, reading, writing, history, and others? And how can teachers help all students overcome those obstacles? (research centers and regional labs)
o How can problem solving, reasoning, and higher-order thinking be integrated and emphasized across the curriculum? (research centers and regional labs)
o How can mathematics and science instruction be strengthened throughout the system, particularly in the early grades? (research centers)
o As school principals are asked to take on new roles--roles that many are unprepared for--how can we train a new generation of promising school leaders? (Principal Training Initiative)
o How can teacher education be altered to increase the instructional effectiveness of teachers entering classrooms in America? (Research Center on Learning to Teach)
o What is the picture of teacher supply and demand, teacher characteristics, and teacher working conditions in the U.S.? (Schools and Staffing Survey)

o What instruments and procedures can be used to evaluate the performance of teachers? (Research Center on Teacher Performance Evaluation and Educational Accountability)

Restructuring

o Of the hundreds of "natural experiments" underway in States, communities, and schools across the country, which experiments are producing useful results? (Evaluation of Education Reform Initiative and other research)
o What research, data collection, and regulatory flexibility will be required if the Nation is to advance toward the new national goals? (Education Summit Follow-Up Initiative)
o Of the various education policies employed by States, districts, and schools across the country, which policies promote optimal learning for all students? (Research Center on Education Policies and Student Learning)
o How can school finance promote the twin ideals of American education--education equity and education excellence--without slighting or jeopardizing either? (Research Center on Education Finance and Productivity)

Adult Literacy, Workforce Quality, and Postsecondary Education

o What kinds and levels of literacy and other intellectual competencies permit full participation in the work and civic life of this Nation, and how can these competencies be made the possession of every adult in the U.S.? (Research Centers on Adult Literacy and on Education Quality of the Workforce)
o How can teaching, learning, and assessment be improved in colleges, universities, and other postsecondary institutions? (Research Center on Postsecondary Learning, Teaching, and Assessment)
o What are the characteristics, salaries, workloads, and other issues affecting faculty in higher education? (National Survey of Postsecondary Faculty)

A Final Question

How will this information help the people in your congressional district?

As part of our national dissemination strategy, which will include a Center on Research on Dissemination and Knowledge Utilization, OERI will supply your office with key publications written for parents, policymakers, educators, and others. For instance, we will release late this summer a booklet on how parents can help their children learn science. We plan to send every U.S. Congressman a copy.

We hope you and your staff will read it, photocopy it, excerpt it, quote it, and most important, pass parts or all of it (and other OERI publications) along to constituents who can use the information to improve teaching and learning in your district.

That, finally, is where our interests overlap. And that is how we can together help people in our States and communities back home build the best schools in the world.

The Demand for Education Research and Statistics

Christopher T. Cross
Assistant Secretary for Educational Research and Improvement
Office of Educational Research and Improvement (OERI)
April 4, 1990

1. **Lots of people and groups are calling for more federally supported R&D.**

o President Bush and the Governors have agreed that the Federal role in helping Americans achieve the new national education goals consists mainly of two parts. First, we must promote equal intellectual opportunity. Second, we must provide "research and development for programs that work; good information on the real performance of students, schools and states; and assistance in replicating successful State and local initiatives."
o The National Center on Education and the Economy, whose chairman is John Sculley, president of Apple Computers, says, "The Federal Government's investment in national statistics and educational research must be increased if the restructuring program is going to succeed."
o Governor Clinton: "There needs to be more research and development in education. We don't really spend very much on R&D; we certainly don't spend very much on applying what we learn."
o Gordon Ambach of the Council of Chief State School Officers: "The appetite for this information [education R&D] far exceeds the current capacity to deliver. The system for collecting nationwide information about education has long been on a starvation diet."
o Pat Graham, Harvard dean of education: "If we are serious about changes like decentralizing school management, then we need to invest more significantly in finding out how to do it. If the executives of a company tried to make changes of such magnitude with such a small investment in research, the stockholders would have their heads."
o The New Republic: "Research is one area in which Bush did ask for more money, and Congress should give him even more than he asked for."
o Denis Doyle, research fellow at the Hudson Institute and co-author of Winning the Brain Race: "U.S. data and education R&D is simply inadequate. By any measure."
o Lois-ellin Datta of the General Accounting Office told the Senate Subcommittee on Government Information and Regulation last year: "We are gathering much less [education] information than in earlier years despite the large increase in interest in the performance of the Nation's education system."

2. **Educators have called for more R&D.**
o In the weeks before the summit in Charlottesville, reports

Education Week, **"Educators...urged an increased federal focus on research and assessment."**
o Al Shanker: "We urgently need to search for structures and strategies that will reach the vast majority of students who fail or achieve at a low level. There are no ideal models currently available, nor will there probably ever be a single best way of educating all students. But there are examples of the kind of thinking needed to develop more effective roles for teachers and supervisors alike."
o Mary Futrell: "We must ensure that it's [education research] **expanded** and is user-friendly...." (Fall 1989)
o The American Federation of Teachers and the National Education Association have each launched a new center to support educational experiments and innovations. AFT's Center for Restructuring will serve as a clearinghouse on restructuring and will conduct R&D linked to restructuring efforts. NEA's National Center for Innovation in Education will provide research and technical assistance to members.
o According to Teacher Magazine, teachers at El Cerrito High (California) are "...**research fans. Research has been the basis for reforms**" in this school as well as others, from California to Maine.

3. **A number of other groups and individuals have indicated their support, in one way or another, for education R&D**, including:

o The Education Commission of the States
o The Business-Higher Education Forum
o The Commission on Workforce Quality and Labor Market Efficiency
o Council on Competitiveness
o The National School Boards Association
o Science, the journal of the American Association for the Advancement of Science
o William Woodside, Primerica Corporation
o Derek Bok, President of Harvard

4. **R&D is critical to American business and industry; consequently, many see it as essential to improving the performance and productivity of education.**

o According to the Department of Energy, some American corporations have developed as much as 50 percent of the current market products from R&D in the past three years.
o According to Lewis Perelman, research fellow at the Hudson Institute, a recent Business Week study found that "...**the amount of R&D investment per employee is the most powerful predictor of business success.**"
o David Kearns, of Xerox: "No single feature of the education system is more shocking to business leaders than low levels of education research spending."
o Various less well-known business executives have spoken publicly about the need for education R&D, including G. Carl Ball, a

vegetable seed merchant, and Jerry Hume, chairman of the board of American Basic Foods.

o Ted Fiske, education reporter for The New York Times, claims that **"Education has, arguably, the worst productivity record of any major industry."** That can change. As Fiske points out, "[b]ecause education is so labor intensive, the potential for improving productivy is enormous." But, he continues, "It is difficult to imagine that...[current reforms] will have much impact unless schools figure out how to make better use of the resources they already have."

o Daniel Morales-Gomez, Senior Programme Officer at International Development Research Center, Canada, writes that "Without an effective link between planning and research, planning education becomes a limited exercise, which responds to the most immediate pressures facing those formulating and implementing policies."

5. **Good research is being used.**

o 41 percent of the Nation's school districts were operating some kind of "effective schools" program in 1987-88; another 17 percent were planning, at that time, to implement an effective schools program within the next two years. In other words, **it appears that some 58 percent of the 16,000 school districts in the U.S. have altered to some degree the way they operate because of effective schools research.**

o "Several states have begun recently to incorporate the findings of the 'effective schools' research into their regulatory systems," according to the National Governors' Association.

o The National Conference on Educating Black Children has stated that using "effective schools" research is the best approach for achieving the group's education goals.

o Six of the nation's largest eight school districts are moving toward school-based management, an approach that grew out of research showing school autonomy to be strongly associated with school effectiveness.

o Bill Honig, Superintendent of Instruction for California, has been referred to as an "education research junkie." He said that the State, in designing one of its new curriculum frameworks, "built the guidelines around research."

6. **The National Assessment of Educational Progress (NAEP) receives a great deal of attention.**

o The Washington Post wrote in January that NAEP "is turning out to be **a gold mine** of concrete information in a field normally starved for it."

o In January, NAEP findings on reading and writing were the subject of at least seven editorials or op-eds in major newspapers--by Tom Wicker, David Broder, William Raspberry, Haynes Johnson, Al Shanker, the aforementioned Washington Post editorial, a Wall Street Journal editorial. Public television's Washington Week in Review made the NAEP results one of its topics of the week.

7. **The top policymakers in the Department of Education have called for more education R&D.**

o Secretary Cavazos: "The Federal Government will have to dramatically--dramatically--improve its efforts at data collection and measurement."
o Under Secretary Sanders: "I think the best thing State and Federal Governments can do together is to provide leadership and information about the condition of education and to give assistance in accumulating information about what works and the directions to be taken."

Conclusion

Only the Federal government has the capacity to support sustained education R&D on a large scale. As "natural experiments" proliferate in schools and communities across the country, Americans must sort out and build upon experiments that actually improve student learning. This will require considerably more information than ever--certainly more than is currently available--from education research and statistics.

FY 1991 BUDGET REQUEST -- OERI
(figures in millions)

I. **Research** (including development and dissemination) - $61.3

- $21.8 Centers
  - A vastly improved array of 25 National Research and Demonstration Centers which will focus on such priority areas as: families, communities, and children's learning; student learning, writing and literacy; learning to teach; education in the inner cities; testing and assessment; and the educational quality of the workforce
- $1.0 Field Initiated Research Grants
  - A small but significant increase in support of individual researchers to broaden the portfolio of research; in the past, Field Initiated Studies has supported research on the effects of education reform on at-risk students, developing language skills in language minority students in a cooperative learning environment, and studies of the effects of accountability measures on retention
- $20.0 Regional Labs
  - Includes establishing the tenth Lab for the Pacific Basin
  - These funds are supplemented by $4.8 million carry-over FY 1990 money from the Rural Education Program (now to be fully incorporated into all Lab contracts)
- $6.7 ERIC
  - Congressionally mandated system includes 16 subject-specialized clearinghouses
- $11.9 Other activities
  - Programs that track educational reforms and synthesize research findings to make them available to parents, teachers, administrators, and others who can effect change at the local level

- National dissemination strategies and production of quality publications of statistical compilations and analyses of research findings

II. **Statistics** (data collection and analysis) - $41.5

- $36.7 Congressionally mandated work
- $3.2 Automated data processing and analysis
- $1.6 Other support activities

III. **Assessment** (National Assessment of Educational Progress) $18.9

- Congressionally mandated work
- Includes continuing development of state-level trial assessments in mathematics and reading
- This work in statistics and assessment provides the foundation of the Federal role in education to gather and report on a timely basis information on the condition of education. The activities proposed in the 1991 budget are a continuation of that endeavor. Much of the work is an essential part of the efforts to monitor progress toward the national education goals

IV. **President's Initiatives** - $53.0

- $3.0 Evaluation of Educational Reforms particularly those schools, districts, and states undertaking restructuring efforts
- $5.0 Dropout Prevention activities:
  - $3.5 A series of grant competitions to support projects that identify and document specific approaches that improve high school completion and the overall performance among disadvantaged secondary school students

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- $1.5 A National Research and Development Center on Dropout Prevention which in addition to conducting research would provide advice and technical assistance to the grants projects, especially on program evaluation, and help to disseminate the results of the projects and its own research

- $25.0 Training and Development of Principals
  - training and development of Principals to fill the need for effective leadership in the schools themselves

- $20.0 Summit Follow-Up activities
  - $4.0 Technical assistance
  - $9.5 Improving and creating data collections
  - $5.0 Additional applied research on:
    - how parents can help their children be ready for school
    - how to improve the recruiting, training, and development of teachers in math and science
    - what schools and employers can do to improve readiness for work
    - how to improve school environment to enhance student learning.
  - $1.5 Increased dissemination efforts including:
    - A series of regional forums highlighting successful programs and encouraging their replication
    - Two community demonstration projects to encourage community-wide coordination of activities to improve education performance (for more detail, see attached)

$20.0 EDUCATION SUMMIT FOLLOW-UP

Introduction

The President and the Governors, in announcing the national education goals, noted that "a new standard for an educated citizenry is required" and that "[s]weeping, fundamental changes in our education system must be made." The goals are a clear assertion of this new standard. They focus on achievement, on results in education, and not merely upon inputs into the education process. All who play a role in education must be held accountable for the achievement of results. In the words of the President and the Governors, this includes educators, parents, students, communities, business and civic groups, and State, local and Federal government.

The Department of Education would use the $20 million in fiscal year 1991 funds requested for Education Summit Follow-up to support the activities outlined below. This is a plan for activities that are not elsewhere included in the Education request. The activities proposed are in addition to a host of other work that is dealt with elsewhere in the Department's request (and in the requests of other agencies as well). The plan provides additional detail that could not have been included in the original budget submission because of the timing of the announcement of the national goals. The activities proposed need to begin during fiscal year 1991 or else an entire year will be lost (a crucial point for activities related to research and data collection related to the national goals since it takes so long to develop, test, and put into use appropriate data collection instruments where none already exist). Resources needed for activities related to the national education goals in fiscal year 1992 and beyond will be reflected in regular budget requests.

Providing Technical Assistance

As part of the Summit Follow-up, the Department would provide assistance to State and local officials who are pursuing the national goals. Funds would be used to supplement the activities of the National Cooperative Education Statistics System to support State and local efforts to monitor progress toward the goals. Technical assistance would be provided for the development of, and collection of data for, indicators tailored to local conditions and needs. Following the development of State plans, financial assistance would be provided to the States using the existing mechanisms of the National Cooperative Education Statistics System.

The estimated cost of this activity is $4.0 million.

Monitoring Progress Toward the Goals

The President and the Governors have called for yearly assessment of the Nation's progress toward the national education goals. The Department of Education will be a primary source of information for that monitoring. In

some cases, much information is already collected regularly; in other cases, the modification of existing data collection programs and the initiation of new ones will be required to provide the solid information base necessary for monitoring progress toward achievement of the goals.

In 1991, funds would be used to:

- Synthesize knowledge on school readiness and begin to develop a consensus on measures or indicators of children's readiness to learn;
- Analyze data from the Current Population Survey to establish a baseline for monitoring progress toward the high school completion goal and to obtain time series data by mutually exclusive racial and ethnic categories;
- Initiate research to develop alternative assessment procedures, instruments, and assessment designs that are more integrated into instructional practice;
- Develop assessment instruments for foreign languages and world history and cultures;
- Develop and pilot test items for the National Household Education Survey that measure students' involvement in activities that promote citizenship, community service, and personal responsibility;
- Initiate an IEA international mathematics and science assessment to provide time series data to monitor progress;
- Conduct time series analyses of international assessments and comparative education studies;
- Conduct a transcript study with the National Assessment of Educational Progress to collect information on high school coursetaking in science, mathematics, and other subjects;
- Review and analyze the Current Population Survey, the American National Election Survey, and other sources of information to determine a baseline to measure progress toward the goal on literacy and lifelong learning;
- Collaborate with the Department of Labor to develop surveys of the skills and knowledge needed by employers as well as of the training opportunities that exist and are needed;
- Develop an assessment instrument for measuring the general academic skills of college graduates;
- Develop and pilot test items concerning adults' participation in adult education to be included in the National Household Education Survey;

- Conduct a Fast Response Survey of institutions, including public libraries, to identify educational programs for part-time and midcareer students; and

- Analyze the data from the 1989 School Crime Supplement and initiate developmental work on a National Household Education Survey on school environment.

The estimated cost of these activities is $9.5 million.

Developing New Knowledge to Improve Student Performance

We need to learn more about the practices in teaching and learning that actually improve the performance of students and schools. Such knowledge is the bedrock for the thoughtful investment of human and capital resources in education. Without such knowledge we cannot tell whether what we are doing is really helping to improve education, nor can we make the changes that will enable us to achieve the national goals.

Much relevant work is already planned by the Office of Educational Research and Improvement for 1991. However, some additional work is needed to help advance the Nation toward the national goals. This work would be coordinated with that of the new research and development centers, specifically those on dissemination and knowledge utilization; adult literacy; education in the inner cities; families, communities, and children's learning; and organization and restructuring of schools. Funds would be used for:

- A major research program on how parents can help their children be ready for school;

- Applied research to improve the recruiting, training, and development of teachers with substantive backgrounds in mathematics and science;

- Research on what schools and employers can do to improve readiness for work; and

- Applied research to demonstrate how school environment can be changed to enhance student learning.

The estimated cost of these activities is $5.0 million.

Disseminating Information

While we do not have all the answers necessary for achievement of the national goals, we do have many of them. We know through current research, for example, many activities that parents can undertake to help children prepare for school. We have evidence of exemplary practice that will help schools make progress toward the science and mathematics goal. And we can show communities and States how to implement restructuring strategies.

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The Department would use funds in 1991 for two special activities to continue the momentum of the goals and to share the solutions we already have.

- o A series of goal-based regional forums designed to put principals, teachers, and policy makers together with their counterparts who have had the most success in improving student performance. For example, we would put together panels to explain in practical detail what teachers, principals, parents, and others must do to succeed in using school-based management to provide more effective instruction. These forums would be tailored to regional needs and conducted in conjunction with the regional laboratories and national research centers.

- o Two community demonstration projects to saturate communities with research-based information and technical assistance aimed at making progress toward the goals. We would utilize local policy makers and educators as well as non-traditional intermediaries such as public health hospitals, social services agencies, and local libraries. We would chronicle these local efforts and disseminate the results nationally for other communities to use.

The estimated cost of these activities is $1.5 million.

Conclusion

The above work and all additional work of the Department of Education to help achieve the goals will be coordinated with related efforts of other Federal departments, including the Departments of Labor, Health and Human Services, and Commerce. In addition, the Department of Education is examining all of its programs and activities to determine how they pertain to the goals and how they could be strengthened to support achievement of the goals.